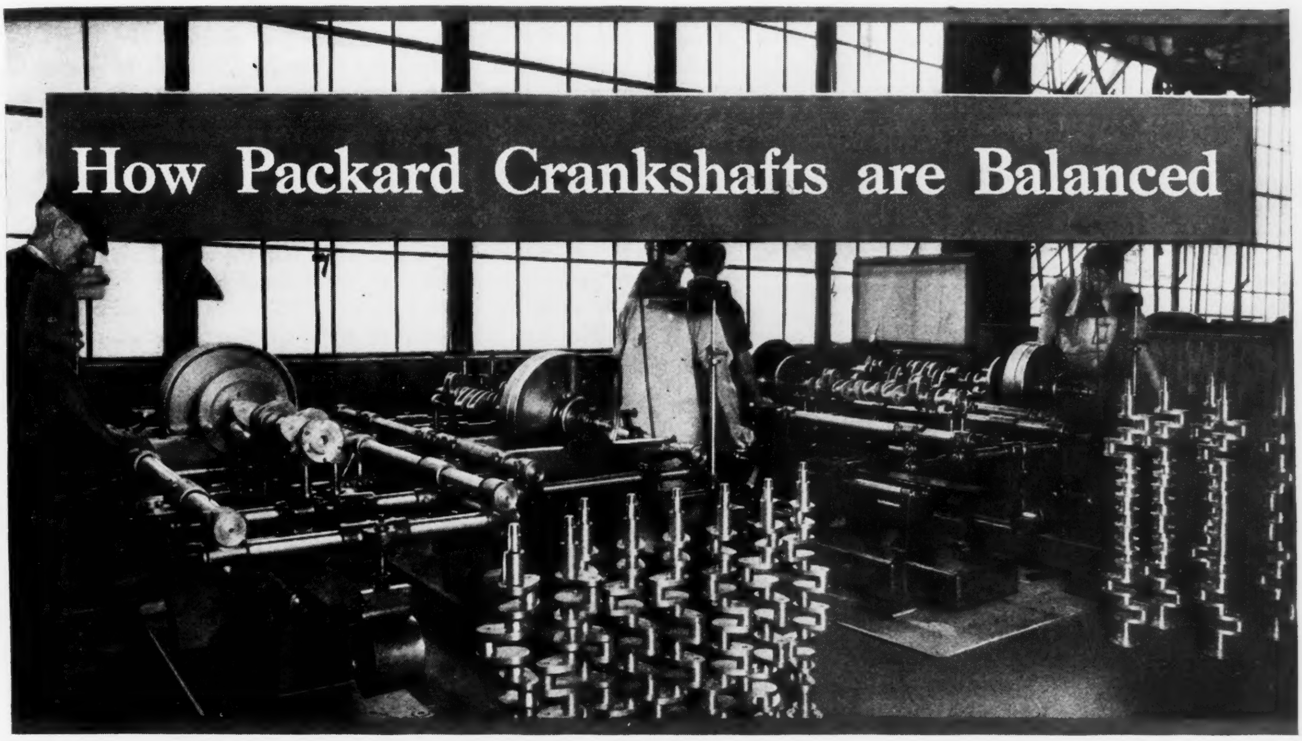
MAY, 1925 VOL. 31 NO. 9

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK



How Packard Crankshafts are Balanced

Balancing Crankshafts by a Method that Definitely Indicates where Unbalance Exists and that Measures the Amount of Metal to be Removed for the Correction

IN MANY plants, the methods used for dynamic balancing involve a considerable amount of guesswork, because the balancing equipment does not readily show how much metal must be removed at predetermined points to balance a machine part. The operator relies to a great extent upon past experience in judging the unbalance, and owing to the uncertainty of such methods, material may be removed by drilling or other means in several places before the unbalance has been corrected. Efforts have been made to place balancing practice on a more rational basis, and through the development of balancing machines now on the market, methods that eliminate guesswork have been developed and are now in use at several automobile plants. One of the plants in which these methods have been highly developed is that of the Packard Motor Car Co., Detroit, Mich.

Requirements of Successful Balancing Practice

A successful balancing machine must permit of the development of balancing methods that insure accuracy. The machine should weigh the amount of unbalance and locate the point of correction. It should give indicator readings that eliminate guesswork or manipulation by the operator. It should be possible to balance rotating parts at a comparatively low cost, so that the balancing operation can be placed in the production line and be expected to produce at a reasonably fixed rate per day or hour.

When the corrections are made, the balancing operation should be complete, and dynamic balance should be obtained without a preliminary static balance. The operation of the machine should be simple, so that high skill on the part of the operator is not required. These conditions, according to the engineers of the Packard Motor Car Co., have been met in the practice of the Packard plant. In carrying out the balancing operation, use is made of four precision balancing machines built by the Gisholt Machine Co., Madison, Wis., in which only one operation is required for balancing both statically and dynamically.

Packard Balancing Practice

In determining upon the methods of balancing, certain restrictions were laid down by the engineering department of the Packard company, which made the development of satisfactory balancing methods especially difficult. The principal restriction was that holes must not be drilled to correct unbalance, because of the disfigurement and the possible weakening of the crankshaft.

Before deciding on the exact method of balancing to be employed, after having determined the amount and location of the balance, consideration was given to the following five methods: (1) By varying the bore of the hole in the crankpin; (2) by using calibrated plugs in the crankpin holes; (3) by beveling the crankarms at the end opposite the crankpins; (4) by removing metal from cheek of crank-arms; and (5) by removing metal from periphery of crank-arms.

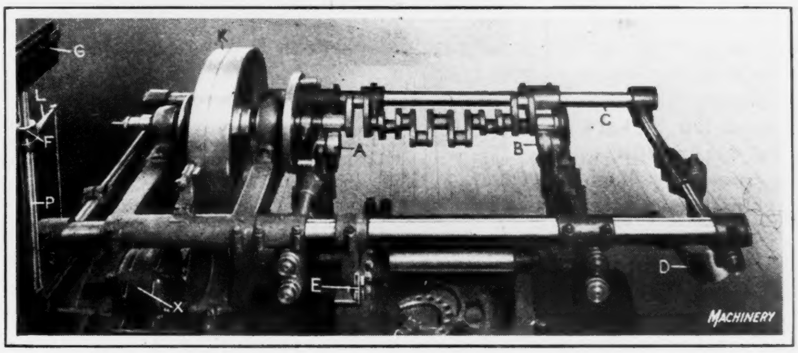


Fig. 1. Crankshaft in Position for checking the Balance of the Flywheel End

On account of the expense and inconvenience, the first method was regarded as impractical, and the second method was considered too likely to produce errors from the fitting of wrong plugs. The third method—beveling the crank-arms—at first seemed too slow and costly, although satisfactory in principle. However, the objections were removed by substituting a turning process in a lathe for the milling process at first considered. The fourth and fifth methods were also considered satisfactory, provided the stock was removed from the surface by grinding; but while the fifth method was temporarily adopted, the third method, of turning off uniform layers from the bevel on the crank-arms, has been adopted as the best practice.

Fig. 2. Setting of the Calculator Rule for determining the Ounce-inch Value of the Amplitude of Vibration in the First Reading

Principles of the Balancing Machine Used

Of the four machines used in the Packard balancing department, as shown in the heading illustration of this article, two machines are used for determining the unbalance of six-throw crankshafts, and two for eight-throw crankshafts. Fig. 1 shows a crankshaft in place in the machine for testing. The procedure consists of determining the unbalance first of one end of the crankshaft, and then of the other, making the corrections by turning, as previously mentioned.

In the illustration the crankshaft is shown in position for determining the unbalance of the flywheel end, the gear end being attached to the headstock spindle by a flexible coupling, through which the crankshaft may be rotated. The main bearing at each end of the crankshaft rests on two rollers as shown at *A* and *B*, which are adjustable both for height and lateral position. These rollers revolve freely on ball bearings.

The headstock and rollers are carried by a frame *C*, which is supported by a large flat spring *D*, the frame being free to swivel about two points *E*, one of which can be seen at the front of the machine. The amount that the frame will swivel or vibrate depends upon the unbalance of the crankshaft when rotated.

In balancing a crankshaft, power is transmitted to the headstock from a small motor *X* on the base. When the crankshaft attains a speed a few revolutions above the critical speed—in the case of the Packard six-throw crankshafts, about 100 to 110 revolutions per minute—the power is disconnected. The drive is conveniently controlled through a foot-pedal.

When the drive has been disconnected and the unbalanced shaft has slowed down to a point where the number of revolutions per minute is equal to what is known as the "natural period of vibration" of the frame, the centrifugal force of the unbalanced element in the crankshaft causes the frame to vibrate with an amplitude that is proportional to the unbalance. This principle makes it possible, through the construction of the machine, to measure the exact amount of unbalance in convenient units, and also to determine the angular location of the unbalancing force. The natural period of vibration of the frame may be adjusted to any required number of revolutions per minute.

Post *P*, Fig. 1, supports a spring *L*, which is connected by a fine wire to the pivoted frame. On the post *P* is also mounted a collar *F* which supports a dial indicator. The feeler of this indicator bears on spring *L*, so that the amount of movement of the spring, due to the oscillations of the frame, may be conveniently read on the indicator. The reading thus obtained is an index of the unbalanced force in the crankshaft; from this reading the actual weight of the unbalanced mass may be determined by a simple calculation, and the angular plane of the unbalance may also be found. The simplicity of the entire balancing operation is, therefore, at once evident.

The Calculating Rule and Its Use

In balancing any part on the Gisholt balancing machine, the value of the unbalanced force measured in "ounce-inches" is obtained by multiplying the value found on the indicator by a constant that represents the calibration of the machine. This calculation may be conveniently made on a patented form of slide-rule *G*, Fig. 1, close-up views of which are shown in Figs. 2 and 3. This device has a finder *H* on the stationary portion, and a finder *J* on the slide-rule. Finder *H* is always set to a graduation that represents the calibration of the machine, this setting in both illustrations being 1.3. Graduation 1 or 1/10 on the slide-rule is always set opposite the graduation indicated by finder *H*, in determining the ounce-inch value of an unbalanced crankshaft, and finder *J* is set to the graduation on the slide-rule that corresponds with the reading obtained on the dial indicator, as shown in Fig. 2. The graduation on the upper stationary scale opposite finder *J* is next observed. This graduation shows the amount of unbalance in ounce-inches.

When the amount of unbalance has thus been determined, a 10-ounce weight in the angle disk *K*, Fig. 1, is moved radially outward the amount corresponding to this reading. This adjustment is quickly made by setting knob *M*, Fig. 4, in a position relative to the vernier that corresponds to the ounce-inch value.

Determining the Angular Location of the Unbalanced Mass

An adjustment has now been made to compensate for the mass causing the unbalance of the crankshaft, but vibration may still exist, due to the angular location of the mass relative to a given point, and this angular position must be located. In determining this, the shaft is again rotated in the machine and a second reading is obtained from the dial indicator with the weight in the angle disk set as mentioned. Then with finder *J* still at the first reading on the slide-rule, as in Fig. 2, the slide is moved until the graduation that finder *J* indicates coincides with the graduation on the

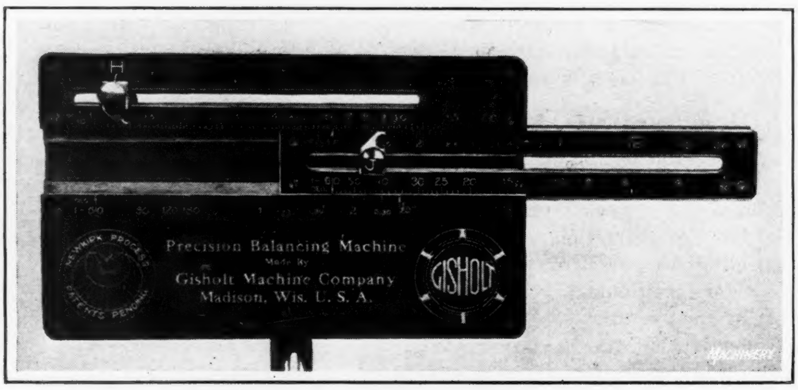


Fig. 3. Method of using the Calculator Rule for determining the Angular Location of the Mass in the Crankshaft causing the Unbalance

upper scale that gives the second reading obtained on the dial indicator, the position thus obtained being shown in Fig. 3. By observing the graduation on the lower side of the slide that is then opposite either the extreme right- or left-hand end graduation on the lower stationary scale, an angular reading is obtained that indicates the angular position of the mass that causes the unbalance of the crankshaft.

The portion of angle disk *K*, Fig. 1, to which the weight is attached is then loosened from the remainder of the disk by simply rotating a handle, and turned relative to it until the angular position given by the scale is reached, when the two parts are again locked together. The correct setting of the angle disk is readily obtained by means of the graduations shown in Fig. 5.

Correction has now been made in the angle disk to compensate for both the amount and the angular location of the mass causing unbalance, and when the work is again rotated there will be no vibration of the frame, provided the settings have been correctly made. Should it happen that instead of freedom from vibration, there is greatly increased vibration, it indicates at once that the angle disk has been set in the wrong direction from zero, and when it is swung the same number of degrees in the opposite direction freedom from vibration will result.

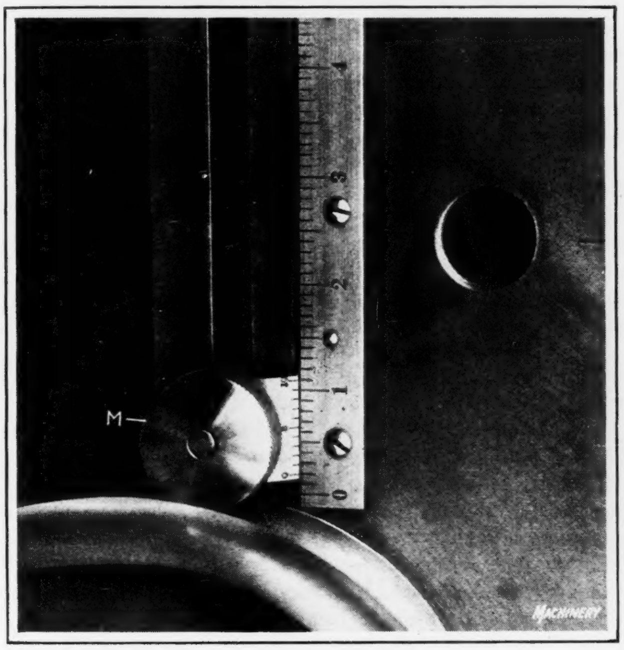


Fig. 4. Vernier on the Angle Disk by Means of which the Compensating Weight is set in Accordance with the Ounce-inch Value

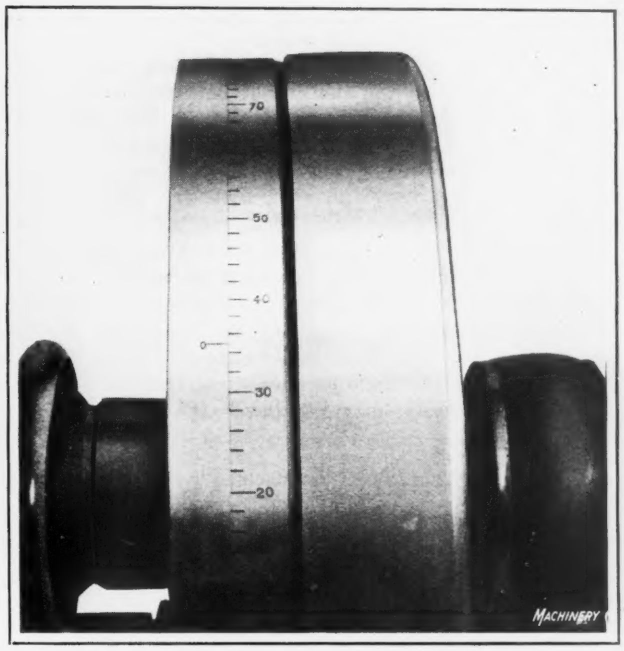


Fig. 5. Graduations on the Angle Disk which facilitate setting it to compensate for the Angular Location of the Unbalancing Mass

How Machine was Applied to Balancing Packard Crankshafts

To facilitate balancing the six-throw crankshafts, two crank-cheeks near each end purposely are made heavy so that the unbalance will exist in these cranks, thus eliminating any correction on the two central cranks. In applying the machine to the balancing, data were obtained as to how much stock should be removed from each crank-arm for correction under various conditions. Turning cuts of various depths were computed mathematically for the respective values in ounce-inches reading of the machine. From this research, a chart was computed giving the operator, at a glance, the amount of stock to remove in thousandths of an inch from the crank-cheeks for any combination of readings obtained.

After these different values are once obtained, they are correct for all duplicate crankshafts, so that the cost of the trials for computing the chart is a small one, compared with the simplicity of the balancing operation when the amount of metal to be removed for any extent or location of unbalance is definitely known. Charts of this type are made up by the Gisholt Machine Co., for different types of crankshafts and other parts to be balanced on the machine.

Correcting the Unbalance by a Machining Operation

After the unbalance of a crankshaft has been determined on both ends of the shaft, and the amount of stock to be removed has been marked in crayon, the crankshaft is sent to a lathe fitted with a dial indicator to show the travel of the carriage. The cross compound feed is set at the proper angle of the bevel on the cheek of the crankshaft. The operator sets the indicator to zero before beginning to cut, having the tool just touching the work. Then after feeding back the cross-slide until the tool is just clear of the bevel, he moves the carriage over the amount of the cut to be taken, as previously specified by the balancing chart and as marked in crayon on the shaft. He then feeds in the cross compound feed until the cut is completed, after which, he feeds back, taking a very light finishing cut. About seventy-five crankshafts can be checked and rechecked per day by one man. In many plants the rechecking operation would not be considered necessary; the fact that it is done is merely an evidence of the great care taken in insuring perfect balance in high-grade automobiles.

A Specific Example of Balancing

Balancing operations are difficult to follow at first, and to insure that the reader will fully understand the simple procedure used with the machine described, a specific example will be given. Assume that a reading of 1.5 is obtained on the dial indicator in the first reading taken in determining the unbalance of the flywheel end of a crankshaft. Then if the calibration of the machine is 1.3 as indicated in Fig. 2 by finder *H*, when finder *J* is set at 1.5 on the slide-rule and graduation 1 on the slide-rule coincides with the graduation indicated by finder *H*, finder *J* will coincide with 1.95 on the upper stationary scale. Then the 10-ounce weight on the angle disk will be moved radially until the position of knob *M*, Fig. 4, is at 1.95 on the vernier.

The second reading is now taken, and it will be assumed that the indicator moves to 0.9. Then the slide-rule is pulled to the right until finder *J*, which remains clamped in the original position on the rule, coincides with graduation 9 on the upper stationary scale as shown in Fig. 3. The angle reading is then determined by observing the graduation on the lower edge of the slide-rule that is directly above the right-hand graduation on the lower stationary scale. It

will be seen that the angle is about 35 degrees. In some instances, the slide-rule will extend from the left-hand side of the device, in which case the angular reading is indicated at the left-hand side of the lower stationary scale. Angle disk *K*, Fig. 1, is now unclamped, moved to the position shown in Fig. 5 and locked, after which the crankshaft is again revolved to insure that no mistakes have been made. If vibration no longer exists, reference is made to the chart which shows that about 0.022 inch of stock is to be removed from No. 11 crank-arm, and 0.016 inch from No. 10 crank-arm; these amounts are marked by crayon on the cranks by the operator. The crankshaft is then placed in the adjacent machine for testing the gear end.

On the six-throw crankshaft, the different cranks are spaced 120 degrees apart and due to the central cranks being made lighter than the end ones, the angle reading will always be between 0 and 120 degrees, the center line of the end crank being considered 0. If the central cranks were made the same weight or heavier than the outer ones, the angle reading might run up to 180 degrees. Should unbalance accidentally exist on the central cranks, this would be seen at once by the angle determination of the machine before any corrections were made.

It will thus be seen that balancing has been considerably simplified by making the end cranks heavier than the central ones. For the same reason, pivot points *E*, Fig. 1, on each side of the frame, which are adjustable, are located between the two end cranks opposite the end being tested.

Balancing an Eight-throw Crankshaft

In determining the unbalance of eight-throw crankshafts, the same procedure is followed as with the six-throw crankshafts, except that the corrections are made on the third and fourth crank-arms on one end, and the tenth and eleventh on the other end. The correction charts read from 0 to 90 degrees, which is the angle between these arms, which have been made purposely heavy to throw the unbalance into this area.

How the Calibration of the Machine is Determined

As previously mentioned, the setting of finder *H*, Figs. 2 and 3, on the calculator rule represents a calibration of the machine by which the first reading of the dial indicator must be multiplied in order to determine the amplitude of vibration in ounce-inches. The value of the calibration depends upon a number of factors, including the position of the pivot points *E*, Fig. 1, and the weight of the crankshaft.. The calibration can be easily checked by using a master crankshaft, in which case vibration does not exist if the angle disk weight is set at zero. A check can also be made with an unbalanced crankshaft, but the use of a balanced crankshaft simplifies the work.

With the master crankshaft, the weight would be set radially a generous amount, say 6 ounce-inches, so as to cause a great deal of vibration, and finder *J*, Fig. 2, would be set at graduation 0.6 on the slide-rule. Then the crankshaft would be rotated, and if the amplitude of vibration were 0.8, the slide-rule would be extended to bring finder *J* opposite graduation 0.8 on the upper stationary scale. The graduation on the upper scale opposite 1 on the slide-rule would then be the calibration constant. The weight should then be moved out 4, 7, or 8 ounce-inches on the angle disk and the calibration rechecked.

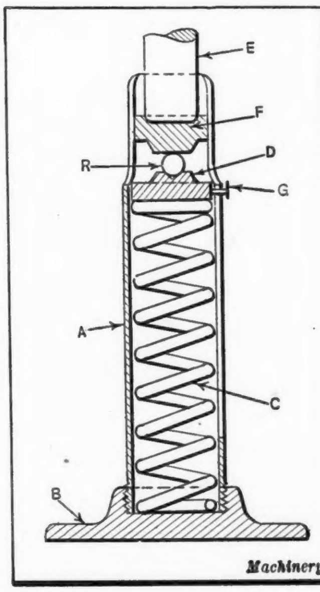
It will be seen that by the use of the balancing machine described and the methods developed in conjunction with it, balancing has been made a comparatively simple process that can be conveniently applied to the balancing of any rotating parts by operations easily understood by any operator, and with all guesswork eliminated. The machines and methods have fully met the expectations of the Packard engineers, and are insuring a high degree of balance in the Packard crankshafts which, because of being finished all over and because of other restrictions imposed, present a more difficult balancing problem than is the case where more latitude is allowed.

HARDNESS-TESTING DEVICE

By E. B. NICHOLS

Some time ago the writer was confronted with the problem of providing some means of inspecting small hardened steel rollers that were produced in large quantities. The rollers were required to be hard enough to withstand the wear and the load imposed on them, and yet not so hard that they would break when in use. After various methods of inspecting the rollers had been tried without satisfactory results, a plan was worked out whereby the breaking or crushing strength of a few rollers from each lot hardened could be tested. If the pressure required to crush these rollers was within certain limits—not too high nor too low—the whole lot was considered satisfactory.

The crushing pressure limits adopted for rollers of various sizes were determined after testing rollers that were known to be satisfactory. The arrangement of the principal members of the device for determining the amount of pressure required to crush the rollers is shown in the accompanying illustration. It consists primarily of a piece of pipe *A*, a base *B*, a coil spring *C*, an anvil *D* for supporting the roller, and a plunger *E* which forces the hammer *F* down upon the roller *R* to be tested. The pipe *A*, which forms the body of the testing device, is 2½ inches in diameter, and is supported in an upright position by the base *B*. The coil spring *C* is calibrated, and the amount of pressure exerted on the roller is indicated on a scale at the side of a slot in the pipe *A* by a pointer *G* attached to the anvil *D*. The plunger *E* is attached to a lever which is hinged to a bracket welded to the pipe *A*. The bracket and the lever are not shown.



Device for testing Breaking Strength of Hardened Rollers

The roller to be tested is located in a V-slot on the anvil *D* under the hammer *F*. The V-slot is about 1/16 inch deep, and serves only as a means of preventing the roller from sliding on the face of the anvil. The test is made by pulling down the lever that operates plunger *E*, which, in turn, forces hammer *F*, roller *R* and anvil *D* downward, thus compressing spring *C*. The downward movement of the operating lever is continued until the roller is crushed or broken. Pointer *G* indicates on the scale the amount of pressure required to cause the roller to fail.

The testing device described is located near the quenching tank in the hardening department, and as each lot of rollers is removed from the tank, a few samples are tested. If these parts withstand the pressure established by the prescribed limits, the complete lot is passed by the inspector. Should the rollers tested prove to be too soft or too brittle, the whole lot is returned for another heat-treatment. The testing device, part of which is shown in the accompanying illustration, was designed to exert a crushing strength of about 350 pounds. A device for testing rollers 1 inch in diameter, having a wall thickness of 3/32 inch, was constructed on the same lines as the one described, except that a screw, operated by a hand-lever, was employed to obtain the necessary crushing pressure.

* * *

In the die-casting field, there has been a gradual resumption of activity. While only a few plants run to full capacity, some of the larger concerns are now occupied to about 75 per cent of what would be considered normal business.

Unusual Gaging Devices and Methods

Prize-winning Articles in MACHINERY's Contest on Interesting Gaging and Inspection Practice
Second Installment

FUSE-HOLE INSPECTION GAGE

By W. R. GRAHAM

Three master fuse-hole gages and pins like the one shown in Fig. 1 were required. The hole for the gage-pin *P* in these gages was bored at an angle of 37 degrees, and was required to be 0.160 inch off center as shown in the illustration. The location of this hole with respect to the center line of the gage was required to be held within limits of ± 0.0001 inch. To measure, bore, and inspect this hole in conformance with these exacting requirements, was a problem that puzzled some of the best toolmakers and inspectors in one of the largest gun factories in the East. It was finally solved in the manner described, by one of the youngest inspectors in the factory who found considerable enjoyment in solving problems of this kind.

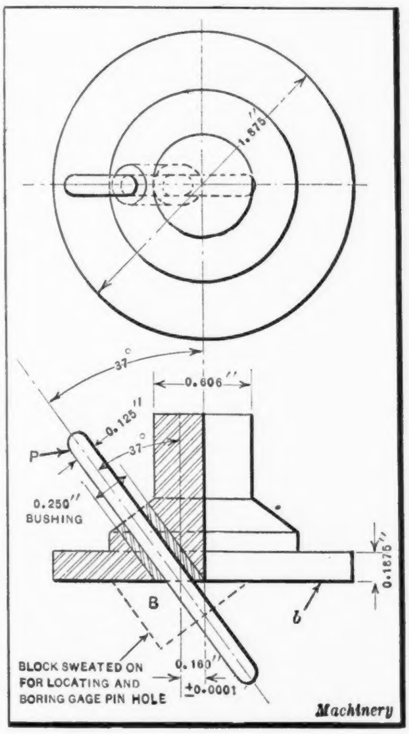


Fig. 1. Fuse-hole Gage

First an accurate fixture, as shown in Fig. 2, was made. All sides of this fixture were accurately ground so that they could be used for measuring when the fixture was located on a surface plate. The recess in the face of the fixture was bored out to a snug fit for the gage shown by the heavy dot-and-dash lines at *A*. Both the gage and the hole were ground to size. Four clamps *F* were provided to secure the gage in place.

The surface *a* was ground at an angle of 53 degrees, and tapped to receive four 3/8-inch cap-screws for clamping the fixture to the faceplate of the precision bench lathe, as indicated in the illustration. This method of mounting the fixture on the faceplate brought the gage *A* in the correct position for boring the pin hole at an angle of 37 degrees, but the bore did not start at right angles to the work, and therefore accurate measuring was very difficult. In order to overcome these disadvantages, a triangular-shaped block *B* was sweated on the surface *b* for use not only in starting the bore at right angles with the work, but also for locating the toolmaker's measuring button *E*, as will be described later.

The most difficult part of the job was to locate the center of the pin hole exactly 0.160 inch from the center line. As an allowance of 0.010 inch was left on surface *b* for grinding, to obtain the 0.1875 inch thickness of flange after boring, the dimension 0.160 was required to be accurate within 0.0001 inch after the allowance of 0.010 inch had been ground from the surface *b*. The slide *D* attached to the fixture as shown in Fig. 2, was made adjustable, although a fixed bar could have been used, provided button *C* was accurately located as explained later.

The fixture was first set up on a surface plate so that it rested on the surface *c*. In this position, button *C* was accurately located on slide *D* at the specified distance of 0.160 inch above the center line of gage *A*. The surface *c* was then clamped to an angle-plate mounted on the surface plate so that the button *C* could be adjusted at right angles to its first position a sufficient amount to bring its center exactly 0.1875 inch above the front face *d* of the fixture, corresponding to the desired finished height of surface *b* of the gage. By locating and taking measurements in two directions, as just described, the center of the button was accurately positioned at a distance of 0.160 inch from the center line and at the same height from surface *d* as the required finished height of surface *b*.

The button *C* was set as described in order to provide a means of accurately locating the second button *E* at a distance of 0.160 inch from the center line of the gage *A*. The button *E* was required to be located and set square not only for the purpose of locating the center line of the hole, but also as a means of truing up the work in the lathe so that the bore could be started at right angles with the work. In order to make this possible, it was necessary for block *B* to be previously sweated on the surface of the gage and be ground parallel with the surface *a*.

The button *E* was first located in a central position, as shown by dimensions *H* in one direction and from button *C* in the other direction after the fixture was mounted on the angle-plate with its surface *a* in contact with the face of the angle-plate, the angle-plate, in turn, being mounted on the surface-plate to permit taking accurate measurements. After the button *E* was accurately located, the whole fixture, with the work in place, was clamped to the faceplate of the lathe, as shown, and trued up with the button *E*. The gage-pin hole was bored and ground for a 0.250-inch hardened bush-

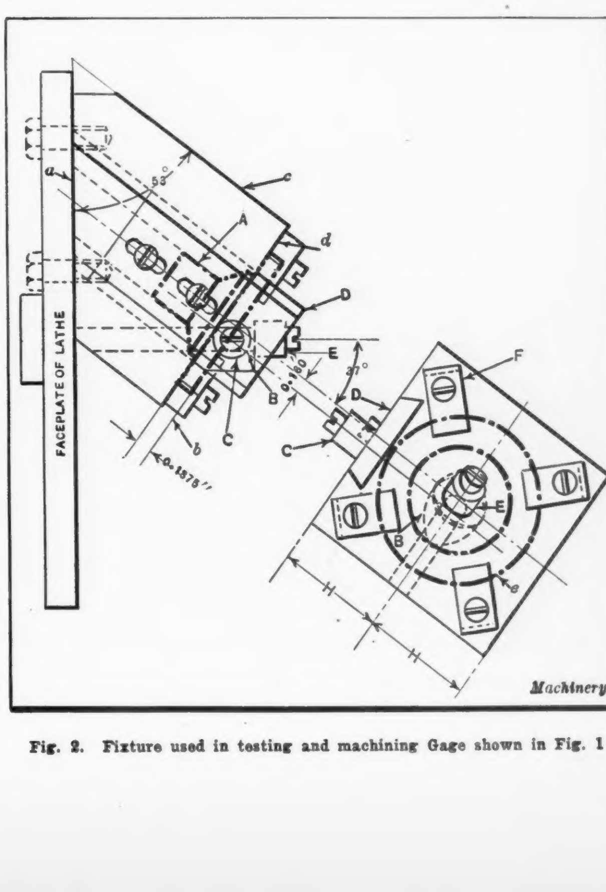


Fig. 2. Fixture used in testing and machining Gage shown in Fig. 1

ing having a pin hole of the required 0.125-inch diameter. If the bushing had not been used, considerable difficulty would have been experienced in keeping the 0.125-inch diameter hole true with respect to the other measurements.

It will be noted that the fixture was used in laying out the work, boring the hole, and inspecting the finished work. The gage-pin was inserted in the gage-pin hole in the inspecting operation to permit the taking of measurements similar to those taken over the button *E* in the setting-up process preparatory to the boring operation. The block *B* which was sweated to the gage to facilitate the measuring and boring operations was, of course, removed from the gage after the hole was bored and ground, the surface *b* being finish-ground after the removal of the block.

* * *

PROGRESSIVE INSPECTION GAGE FOR VALVE ROCKER

By PHILIP F. SHAFRAN

The progressive gage shown in Fig. 2 was designed by the writer for inspecting the valve rocker shown in Fig. 1. The rockers were to be used on airplane engines, and were subject to a rigid government inspection. The gage consists of a cast-iron plate *A*, Fig. 2, which is finished on the upper surface and to which all the gages necessary for inspecting the rocker are securely fastened. The method of gaging dimensions *B*, *C*, *D*, and *E* is clearly shown in Fig. 2, and needs little explanation. A "Go" and a "Not Go" gage are used for each dimension. It will be noted that the gages are designated by the same letter as the dimensions to be gaged. The position of the rocker while being gaged is shown by the dot-and-dash outlines on some of the gages. Slot *F* in the rocker is checked by blocks *F*.

Widths *G* and *H* are gaged simultaneously as shown. The rocker should fit easily in the upper part of the gages and should not enter the lower part. These gaging blocks are arranged so that they also gage widths *G* and *H* in relation to their common center. All the gages are hardened, and the measuring surfaces ground and lapped to size. A spring-actuated flush-pin type of gage is used to gage the depth of ball seat *L* and also dimension *K*. Two plugs *N* and *O* enter holes *C* and *B* in the rocker. The holes have a tolerance of 0.001 inch. The plugs are finished to the smallest permissible diameter of the holes and their centers are accurately spaced so that they check dimension *I*. No further checking of this dimension is required, as hole *C* is drilled in a jig and accurately located by a pilot in hole *B*. Each of the plugs has a finished flange on which the finished faces of the rocker rest, and these flanges locate the ball seat centrally.

Plunger-pin *P* is accurately located so that it also gages dimension *J* of the rocker. The lower end of the pin is made 0.005 inch smaller in diameter than the ball seat and has two fine lines 0.015 inch apart scribed on it to check dimension *K*. A line is scribed near the top of the pin and a 0.015-inch step cut at the top of housing *M* for checking depth *L* of the ball seats. In using this gage, pin *P* is pulled up against the action of the spring so that the rocker may readily be placed on plugs *N* and *O* and the pin dropped into the ball seat.

The writer has found this type of gage very efficient and a great time-saver. All the gages are fastened to one plate, which does away with the picking up and laying down of the gages, as is done with individual plug gages and size blocks.

* * *

GAGE WITH DIAMOND POINTS

By CHARLES F. STEIN

The gage shown in the accompanying illustration has been in use for some time in one of the largest automobile plants in the country. It was designed for gaging the pins of an automobile crankshaft that had to be held to a tolerance of 0.0005 inch. The frame *B* is made of cast aluminum. The gaging points *A* are diamonds inserted in soft steel holders. The holders for points *A* are clamped in place by set-screws *G* when properly adjusted by means of the set-screws *L*.

The screw stop *C* is hardened and ground on its face, and is held in place by a set-screw *P*. The diamond gaging point *D* is held in a plunger which is hardened and lapped. The inserted diamonds give the gage a three-point diamond bearing. The plunger that holds the diamond point *D* slides in the hardened and lapped bushing *E*. Bushing *E* has a keyway for the pin *F* that keeps plunger *D* from turning under the lever *J*.

The stops *K* can be adjusted to permit lever *J* to have any amount of travel required. Part *H* holds the indicator and is screwed and doweled to frame *B*. This part is split on

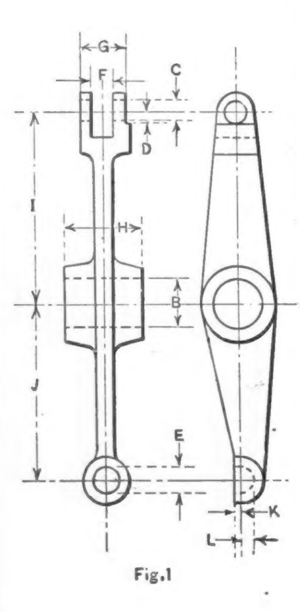


Fig.1

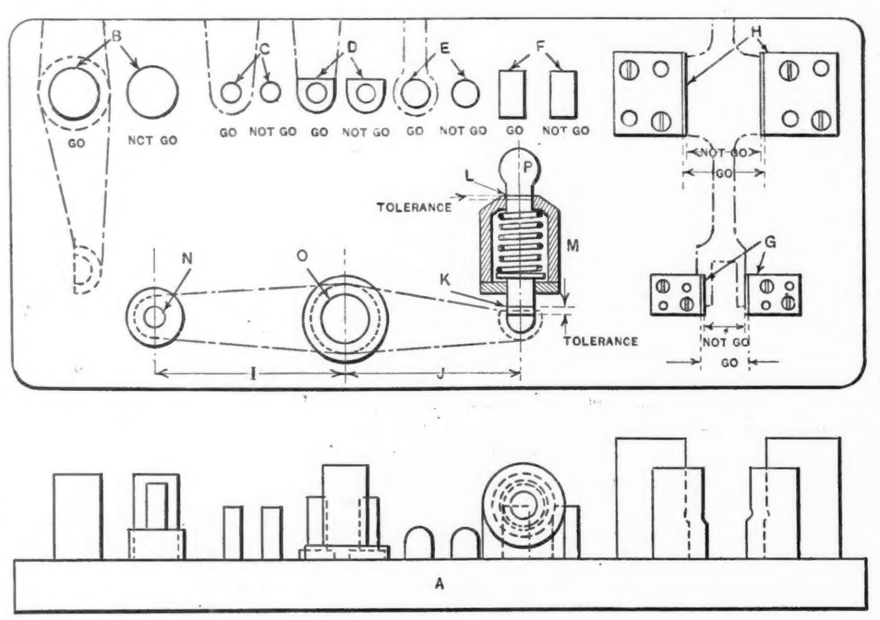


Fig.2

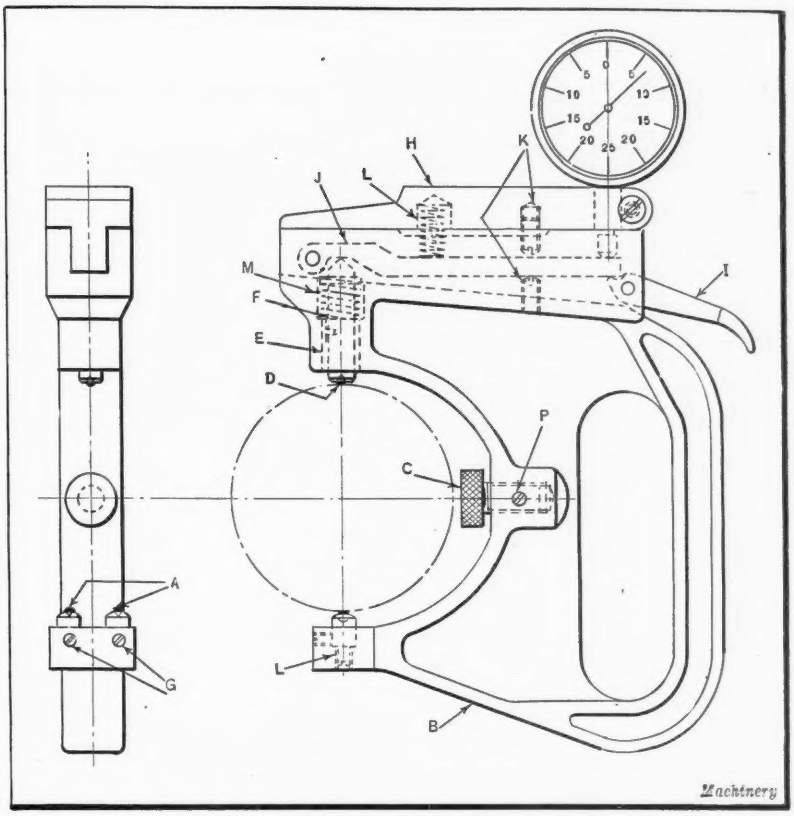
Machinery

Fig. 1. Valve Rocker

Fig. 2. Gage for inspecting Valve Rocker

the indicator end so that when the screw is tightened, the indicator is held firmly in place. The indicator can be made to face in the direction best suited to the operator. Care must be taken to see that the diamonds are not too sharp, or they will cut into the work.

In using this gage, it is first set to a master block. The operator then presses down lever *I* which acts upon lever *J*, the latter lever, in turn, allowing the spring *M* to lift the point *D* out of the way. Next the gage is pushed over the work until it touches stop *C*. Lever *I* is then released which allows spring *L* to push point *D* down against the work. The gage is next pulled back, and the reading taken when the indicator reaches the highest point. Lever *J* has a 10 to 1 ratio, so that when the work varies 0.001 inch the indicator will move 0.010 inch. The diamond points insure an accurate reading, and the indicator can be used by even the most inexperienced operator.



Indicator Gage for Automobile Crankpin

* * *

REPAIRING LEAD-HOLDING COLLET OF A BOW PENCIL

By HUGH H. LEE

Pencil compasses or bow pencils which have become worn to such an extent that the spring collet will no longer hold the lead in place, can generally be repaired by one of the methods here described. If the part that screws over the pronged lead-holding member has been spread open so that it no longer tightens the prongs on the lead, it can be remedied in the following way: A hole slightly smaller than the size of the lead to be held is drilled in a piece of metal and countersunk with a 60-degree countersink. The spread member of the collet is then placed nose down in the countersunk hole and tapped lightly with a small hammer. This operation swages or closes the end in so that it will force the prongs to grip the lead tightly.

If very small hard leads are to be used, it may be necessary to build up the lead-holding member with solder, first applying some acid to the member and then dipping the pronged end once or twice into a pot of molten solder. Care must be taken not to allow the acid to reach the inside of the prongs. Any excess solder can be removed with a file. The end of the lead-holding member can also be coated inside and out with solder in the same manner if desired, and the jaws for holding the lead formed by drilling a hole of about the same size as the lead, and then cutting or filing away the solder that connects or ties the prongs together.

* * *

METAL SPRAYING PROGRESS

In a paper presented before the Institute of Metals, a review of the development of the Schoop metal spraying process up to the present time was given. This method for spraying surfaces with what might be called atomized metal, so as to cover the surface thoroughly with a metal coating, has been in practical use since 1910. It is employed largely for the coating of containers for various purposes with zinc or aluminum. In the paper mentioned, it was stated that the gas-heated wire-melting type of "pistol" has so far proved to be the most suitable type of metal-spraying apparatus. Sand-blasting is generally used before spraying. The pre-heating of the article to be coated frequently improves the adherence of the sprayed coating.

Any metal that is available in wire form and can be fused in the oxy-hydrogen flame may be sprayed on practically any surface—not only on metal, but on paper, fabric, and wood. The surface produced is always matte, but may be polished if desired. The matte surface produced by the spraying is an ideal foundation for paint. Completed structures are now being uniformly coated by this process for protection against corrosion, chemical action, or furnace conditions. By continuously spraying on one spot, it is possible to build up a body of metal suitable for much of the repair and salvaging work required in a shop or foundry. Considerable technical experience has been gained with the process in recent years, and the use of duplex coatings promises to show valuable results in the near future.

* * *

MEETING OF MANAGEMENT ASSOCIATION

The American Management Association will hold a meeting for financial executives at Briarcliff Lodge, near New York City, May 6 to 8. The subject for discussion will be "The Financial Executive's Part in Management." The work and experience of ten representative financial executives will be presented as a basis for the discussion. On May 21 and 22 the Production Executives' Division of the American Management Association will meet in Chicago, the topic of the conference being "Wage Incentives." The secretary of the American Management Association may be addressed at 20 Vesey St., New York City.

* * *

In the first two months of this year over 1600 bills relating to the automotive industry were introduced in the various state legislatures of this country. A review of these bills indicates that many of them are very drastic, and if enacted into law would restrict the use of motor vehicles. Some of the bills are constructive, but the majority were drawn up without a proper investigation of the need for such laws. If more attention were given to the enforcement of existing laws, there might be less need for so many additional ones.

* * *

In the United States there is one motor vehicle for every 7 people; in the United Kingdom, one for every 74 people; in Mexico, one for every 634 people; and in Hungary and Japan, one for every 7200 people.

Interchangeable Worm-and-Gear Speed Reductions

By GEORGE L. HEDGES*

George L. Hedges

WITH the increasing use of direct-connected motor-driven mechanisms using worm-and-gear speed reductions, there develops the problem of designing mechanically interchangeable reductions of different speed ratios so that a given apparatus will have the same operating speed when driven by motors of different speeds. This is particularly necessary in the case of motor-driven domestic service appliances using split-phase induction motors, the speeds of which differ according to the frequency of the power circuit. The speeds and other data for the motors commonly used for this service are given in Table 1.

The object of this article is to show a simple method of determining the best worm-and-gear reductions with the same center distances, that is, reductions that are mechanically interchangeable but that have different speed ratios corresponding to the speeds of the different standard commercial motors, so that the final speed in the mechanism will be the same for any motor. The first step is to calculate the worm-and-gear ratios from the motor speeds and final speeds, and then compute the maximum and minimum pitch diameters of worms that will meet the conditions of the problem. Gear diameters and center distances are calculated for these worms and for intermediate worms having diameters that are approximately half way between the limiting diameters. The center distances and gear diameters thus obtained are compared by means of a system of charting which enables the best value for a common center distance to be selected. The results are checked mathematically.

The method will be made clear by following through the solution of a problem in which we have given: Final speed desired, 55 revolutions per minute, plus or minus two revolutions per minute; pitch of worm and gear, not less than 14 diametral pitch; minimum root diameter of worm, 5/16 inch; minimum thread angle, 18 degrees; and maximum outside diameter of worm, 7/8 inch. The pitch is determined by considerations of strength, wear, and accuracy; the minimum root diameter by stiffness; the minimum thread angle by friction power loss; and the maximum outside diameter by the space available for the worm. With these given values, it is required to find the mechanically interchangeable gear reductions for standard motor speeds. In the solution of this problem, we will let

d = pitch diameter of worm;
D = pitch diameter of worm-gear;
d_1 = minimum pitch diameter for worms having a minimum root diameter of 5/16 inch;
d_2 = maximum pitch diameter for worms having a minimum thread angle of 18 degrees;
d_3 = maximum pitch diameter for worms having a maximum outside diameter of 7/8 inch;
n = number of teeth or threads in worm;
N = number of teeth in worm-gear;
P = diametral pitch (normal to the tooth);
α = thread angle of worm; and
C = center distance.

We also have the formulas,

$$D = \frac{N}{P} \sec \alpha \quad \text{and} \quad d = \frac{n}{P} \operatorname{cosec} \alpha$$

The reason for employing the secant and cosecant functions is that they facilitate the use of the slide-rule in making the preliminary calculations. The solution of the problem should be taken up in the following order:

1. From the motor speeds and the final speed find (a) the limiting speed ratios; and (b) the limiting worm-and-gear ratios.
2. Select the trial pitch, and find the number of teeth in the worm and the gear.
3. Tabulate these data as shown in Table 2.
4. From the factors in the problem that limit the dimensions of the worm next calculate:
   a. The minimum pitch diameter of the worm for a given minimum root diameter;
   b. The maximum pitch diameter of the worm for a given minimum thread angle; and
   c. The maximum pitch diameter of the worm for a given maximum outside diameter.
5. Tabulate the values thus obtained as shown in Tables 3 and 5, Table 5 being a summary of the trial values contained in Table 3.

It should be noted that the maximum pitch diameter of the worm is determined in some cases by the thread angle

TABLE 1. MOTORS USED ON DOMESTIC SERVICE APPLIANCES

Type of Motor	Speed of Motor, Revolutions Per Minute	Remarks
D.C.	1750	Frames of these motors are identical as regards mounting. Direct-current frames are slightly longer than alternating-current frames. These motors comprise about 95 per cent of domestic service appliance installations.
60-cycle	1750	
50-cycle	1450	
50-cycle 25-cycle	1450	Frames of these motors are identical. They are larger than the frames in the group above. They comprise about 5 per cent of domestic service appliance installations.
40-cycle	1150 2350	

Machinery

*GEORGE L. HEDGES graduated from the University of Nebraska in 1907. After doing engineering work in Lincoln, Neb., for two years, he became connected with the Kelman Electric & Mfg. Co., of Los Angeles, Cal., soon becoming engineer of the company. In 1917 he entered the Ordnance Officers Reserve Corps as first lieutenant, and when called into active service was made manager of the stores and scrap division in the Bridgeport District Ordnance office. After the war, he was in the employ of the Stewart Wire Wheel Co., of Frankfort, Ind., and the P. A. Geier Co., of Cleveland, Ohio, until, in 1924, he became mechanical engineer of the Hedges Lincoln Iron Works, Lincoln, Neb., a business established by his grandfather fifty-two years ago.

TABLE 2. FACTORS THAT LIMIT CHOICE OF GEARS

Motor Speed	Limiting Speed Ratios	Limiting Worm-and-gear Teeth Ratios	Trial Worm
1750	$\frac{1750}{53} = 33.0$ $\frac{1750}{57} = 30.7$	$\frac{66}{2}$ or $\frac{99}{3}$ $\frac{61}{2}$ or $\frac{92}{3}$	Try 10-pitch, double thread.
1450	$\frac{1450}{53} = 27.4$ $\frac{1450}{57} = 25.4$	$\frac{55}{2}$ or $\frac{82}{3}$ $\frac{51}{2}$ or $\frac{76}{3}$	Try 12-pitch, triple thread or 8-pitch double thread.
1150	$\frac{1150}{53} = 21.7$ $\frac{1150}{57} = 20.2$	$\frac{43}{2}$ or $\frac{65}{3}$ $\frac{40}{2}$ or $\frac{61}{3}$	Try 10-pitch, triple thread.
2350	$\frac{2350}{53} = 44.3$ $\frac{2350}{57} = 41.1$	$\frac{89}{2}$ $\frac{82}{2}$	Try 14-pitch, double thread.

Machinery

and in other cases by the outside diameter of the worm. For the 14-pitch worm, the permissible minimum diameter as noted in Table 3 appears to be greater than the permissible maximum diameter—a condition which indicates that this particular pitch cannot be used, as either the thread angle will be less than the given minimum of 18 degrees or the root diameter would be less than the given minimum diameter of 5/16 inch, or both of these conditions would obtain. Therefore, there is no gear reduction for the 2350 revolutions per minute, 40-cycle motor that will meet the conditions, and it will be necessary to use a 40-cycle motor having a speed of 1150 revolutions per minute

The next step in the solution of the problem is:

6. Calculate the gear diameter and center distance for the speed reductions, using worms with the maximum and minimum pitch diameters given in Table 5, and also with intermediate pitch diameters, and using gears, the number of teeth of which is between the restricting values given in the worm-and-gear tooth ratios of Table 2. The tabulations in Table 4 will simplify the succeeding calculations.

7. Construct a graphical chart, as shown in the illustration, drawing a curve for each gear, and using a common scale of center distance as the abscissas, and a separate scale for the pitch diameter of the worm as ordinates. From this chart determine the desired center distance and the approximate corresponding worm pitch diameters for the gears selected. Then make final mathematical calculations to determine the worm and gear pitch diameters and thread angle to the desired degree of accuracy.

For the given problem, the chart shows that the permissible center distances are 3.74 to 3.764 and 3.792 to 3.821 inches, which means that within these limits worms and gears can be selected to meet the limitations of the problem. If it is desired to use 8-pitch gearing for the reduction mechanism of the 50-cycle motor, the permissible center distance is restricted to from 3.792 to 3.807 inches. The value of 3.800 will be selected for the given problem. Thus for the

TABLE 3. MAXIMUM AND MINIMUM PITCH DIAMETERS OF WORMS

Minimum pitch diameters d_1 for worms having a minimum root diameter of 5/16 inch as given here were calculated by the formula:

$$d_1 = \text{Root Diameter} + 2 \times \text{Dedendum}$$

	Diametral Pitch 8	10	12	14
Root Diameter	0.312	0.312	0.312	0.312
Dedendum × 2	0.289	0.230	0.193	0.165
Minimum Pitch Diameter d_1	0.601	0.542	0.505	0.477

Maximum pitch diameters d_2 for worms having a minimum thread angle of 18 degrees are calculated by the formula: $d_2 = \frac{n \text{ cosec } 18 \text{ degrees}}{P} = \frac{3.236n}{P}$

	Diametral Pitch 8	10	10	12	12
Number of Teeth n in Worm	2	2	3	3	2
Maximum Pitch Diameter d_2	0.809	0.647	0.971	0.809	0.462

Maximum pitch diameters d_3 for worms having a maximum outside diameter of 7/8 inch as given here were calculated by the formula:

$$d_3 = \text{Outside Diameter} - 2 \times \text{Addendum}$$

	Diametral Pitch 8	10	12	14
Outside Diameter	0.875	0.875	0.875	0.875
Addendum × 2	0.250	0.200	0.167	0.143
Maximum Pitch Diameter d_3	0.625	0.675	0.708	0.732

Machinery

60-cycle motor (which uses the 10-pitch 2-tooth worm) there can only be used the 66-tooth gear for which the chart shows the corresponding worm pitch diameter to be approximately 0.600 inch. By calculation, the corresponding gear pitch diameter is found to be 7.000 inches and the center distance for this worm and gear 3.800 inch, which is the center distance selected and which shows that the worm pitch diameter of 0.600 inch is correct.

For the 50-cycle motor, there can be used a 12-pitch 3-tooth worm with a gear having 76 or 77 teeth, or an

TABLE 4. SUMMARY OF PRELIMINARY CALCULATIONS

Pitch P	Number of Teeth n	Worm P. Diameter d	Cosecant a	Thread Angle a	Secant a	D (N = 61 teeth)	C (N = 61 teeth)	D (N = 62 teeth)	C (N = 62 teeth)	D (N = 63 teeth)	C (N = 63 teeth)
10	3	0.675	2.2500	26°–24′	1.11600	6.8080	3.7410	6.919	3.797	7.031	3.853
		0.609	2.0300	29°–31′	1.14900	7.0090	3.8090	7.124	3.866	7.239	3.924
		0.542	1.8070	33°–36′	1.20100	7.3260	3.9340	7.446	3.994	7.566	4.054
		0.616	2.0533	29°–09′	1.14502	6.9846	3.8003				
		0.617	2.0567	29°–06′	1.14446	6.9812	3.7991				

Gear Pitch Diameters D and Center Distances C for Different Numbers of Teeth N

Machinery

8-pitch 2-tooth worm with a gear of 51 teeth may be employed. For the 40-cycle motor, a 10-pitch 3-tooth worm with a gear of 61 or 62 teeth will meet the requirements. In all cases the chart gives the approximate worm pitch diameters, and the desired degree of accuracy is obtained by calculation.

TABLE 5. SUMMARY OF MAXIMUM AND MINIMUM PITCH DIAMETERS GIVEN IN TABLE 3

	Diametral Pitch				
	8	10		12	14
Number of Teeth n in Worm	2	2	3	3	2
Maximum Pitch Diameter (Smallest Values from d_2 and d_3)	0.625	0.647	0.675	0.708	0.462
Minimum Pitch Diameter (d_1, Table 3)	0.601	0.542	0.542	0.505	0.477

Machinery

In the example given, the curves in the illustration are shown for gears with all numbers of teeth between the limiting values. In practice, curves would first be drawn for the maximum and minimum number of teeth, and only such other curves would be added as would be required in the solution of the problem under consideration. The values given in Table 4 were calculated for three of the gears for a 10-pitch 3-tooth worm. The first three lines of figures in the table show the results of the preliminary calculations from which the curves for these gears are plotted on the chart. After determining from the chart that a 61-tooth gear will be used with a center distance of 3.800 inch, the chart gives for these values an approximate worm pitch diameter of 0.616 inch. Final calculations using the values 0.616 and 0.617 inch show that 0.616 is the more accurate value. The corresponding gear pitch diameter is then 6.9846 or, say, 6.985 inches.

* * *

SPRING MEETING OF MECHANICAL ENGINEERS

The tentative program for the Spring Meeting of the American Society of Mechanical Engineers to be held in Milwaukee, Wis., May 18 to 21, includes papers on the following subjects: *Machine Shop Session*: "Inertia Problems in High-speed Machine Tools," by Professor J. A. Hall; "Code of Spring Design," by J. K. Wood; "Production of Heavy Forgings," by William Harper. *Hydraulic Session*: "Some Operating and Economic Features in Parallel Operation of Hydro and Steam Plants," by F. A. Allner; "Hydro-electric Plant Design and Operation," by E. A. Dow; "Mechanical Problems of Hydraulic Turbine Design," by William M. White. *Fuels Session*: "A Microscopic Study of Pulverized Coal," by L. V. Andrews; "Radiation in the Pulverized Fuel Furnace," by W. J. Wohlenberg; "Furnaces for Pulverized Coal," by A. G. Christie. *Milwaukee Session*: "The Principles of the Activated Sludge Process of Sewage Disposal as Developed at Milwaukee," by J. A. Wilson; "Critical Study of Heat and Power Requirements of Sewage Disposal Plants," by Robert Cramer; "The New Riverside Pumping Station," by C. A. Cahill; "The Economical Advantage of Cities having Diversified Industries." *Industrial Power Session*: "Torsional Vibration in Multiple-cylinder Oil Engines," by C. B. Jahnke; "Tests on a Unaflow Engine," by G. H. Barrus. *Materials Session*: "X-Ray Investigation of Steel Castings," by E. W. Norris and Dr. H. H. Lester; "Properties of Aluminum and its Alloys," by R. L. Streeter; "Stress Concentration Produced by Holes and Fillets," by S. Timoshenko and W. Dietz. *Materials Handling Session*: Paper Based on Work of Committee on Application of Formulas, by George E. Hageman and J. A. Shepard; Three short papers on "Application," by Messrs. Wadd, Lichtenberg, and Langford. *Steam Power Session*: "Recent Development in Steam Turbines," by Hans Dahlstrand; "Steam Pipe Insulation," by Messrs. Carter and Cope; "Analysis of Power Plant Performance Based on the Second Law of Thermodynamics," by W. L. DeBaufre; "Lake Waters for Compressors," by A. G. Christie. *Management Session*: "Steel Foundry Management," by R. A. Bull; "Management of Gray Iron Foundries," by G. P. Fisher. *Railroad Session*: "Economics of Shopping Steam Power," by Mr. Sillcox; "Freight Car Maintenance," by C. G. Juneau. *Session on Education and Training in the Industries*: "Milwaukee District Apprenticeship Scheme"; "District Apprenticeship Scheme," by Harold S. Falk. In addition there will be a Forest Products Session and a National Defense Session. Excursions will be arranged to a number of plants, including those of the Allis Chalmers Mfg. Co., Kearney & Trecker Co., Falk Corporation, and the Nordberg Mfg. Co.

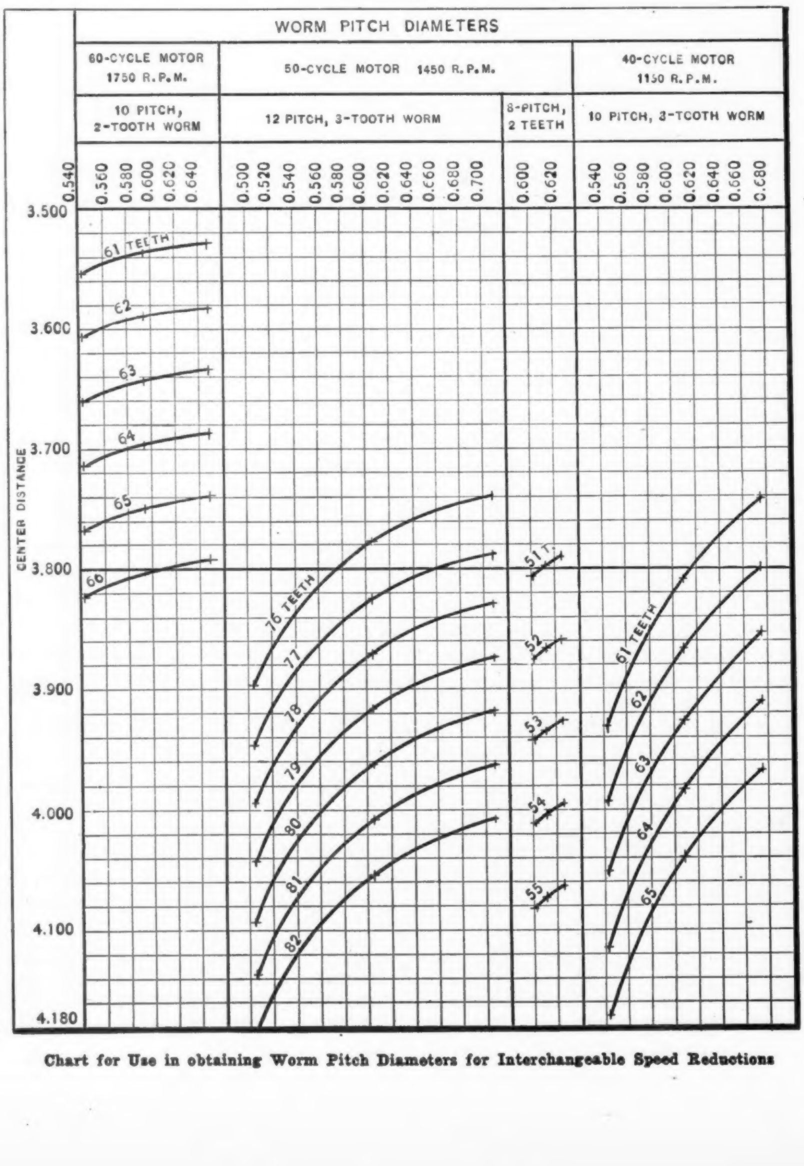


Chart for Use in obtaining Worm Pitch Diameters for Interchangeable Speed Reductions

* * *

It is generally believed that the automobile industry is rapidly being concentrated in the hands of a very few companies. However, *Automotive Industries* points out that while in 1923 and 1924, 87 per cent of all the automobiles built were produced by ten companies, in 1913 the ten leading producers built 81 per cent, and in 1914, 84 per cent of the total output. Hence, the conditions have not changed very much in the last ten years. On the other hand, there are fewer automobile companies in business now than there were ten years ago.

SHOP-MADE FORMED CUTTER

By HENRY SIMON

A type of milling cutter that can be sharpened without changing its form and that can be made in almost any shape is shown in Fig. 1. Although not intended to take the place of solid formed cutters on production work, it can be used to advantage in many instances where form-milling is the only proper method of doing the work, but where the cost of the regular type of cutter would be prohibitive because of the limited number of pieces required. Essentially, the cutter consists of four sections, *K*, *L*, *M*, and *N*, Fig. 2, which are obtained by quartering the formed blank *A* and then rearranging the quarters to form cutting teeth having the proper clearance. The teeth are given the form of a practically solid unit by locking them together with babbitt poured into the spaces between them.

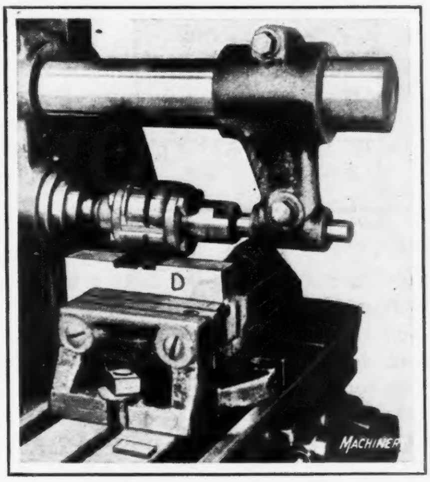


Fig. 1. Formed Cutter used in milling Split Type Dies

A set of four dies of the split type similar to that shown at *D*, Figs. 1 and 2, was to be produced. The shape of the main portion of the four different blanks to be made was required to be the same, and the blades were to be interchangeable. It was necessary that the shape of the dies be kept uniform throughout their entire depth in order to insure long life. The ends of the blanks, however, were all machined differently.

To do this work and hold it within the close limits specified by using several ordinary milling cutters to give the required profile, would have been a very difficult and long drawn out job, and would have provided no means of reproducing the work later. The use of formed cutters made especially for the job would have been too expensive. The idea of employing a fly cutter was abandoned in view of former unsatisfactory experiences in making similar dies by the use of fly cutters.

With the cutter shown in Fig. 1, the form-milling of the entire set of eight pieces, each piece requiring a cut 1¼ inches long, was completed in less than eight hours actual milling time. In each case, the entire depth of the formed outline was taken in one cut except for an allowance for finishing of about 0.005 inch, which was removed in two light cuts. It was necessary to take two milling cuts on each piece, but this would have been done had two solid formed cutters been employed, as it was necessary to tip the pieces at different angles lengthwise in order to make the second cutter produce a slightly different shape. Angular clearance was provided at each end of the piece by an additional milling cut. It is obvious that very little time could have been saved on the milling operations by using solid formed cutters, while at least four times as much time, or thirty-two hours, would have been required to perform the same work with a fly cutter having a single tooth.

In laying out a cutter of the kind described, the size of the miller spindle used and the shape and depth of the form or outline cut in the work will determine the size of the blanks and the finished tool. The cutter in Fig. 1 was designed for use on a one-inch spindle and for work having a maximum depth of 0.250 inch, the blank being turned from 3-inch bar stock. It is desirable to hold the size of the cutter to as small a diameter as possible, not only because of the saving in time and material, but also because of the increased frequency of cuts obtained at the same surface speed.

To insure success in making the cutter, it is necessary that the blank be made from a high-grade non-shrinking

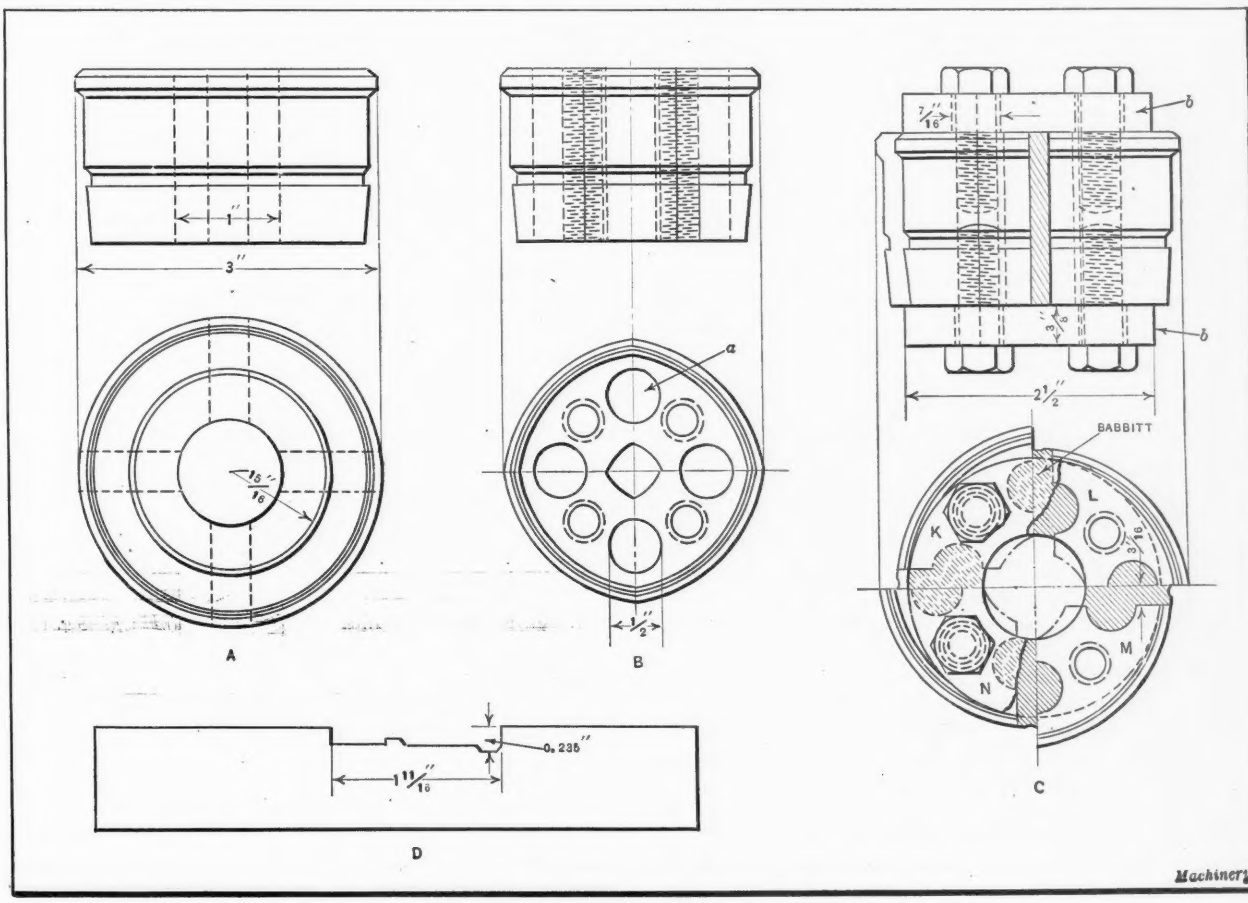


Fig. 2. Progressive Steps in making a Formed Cutter

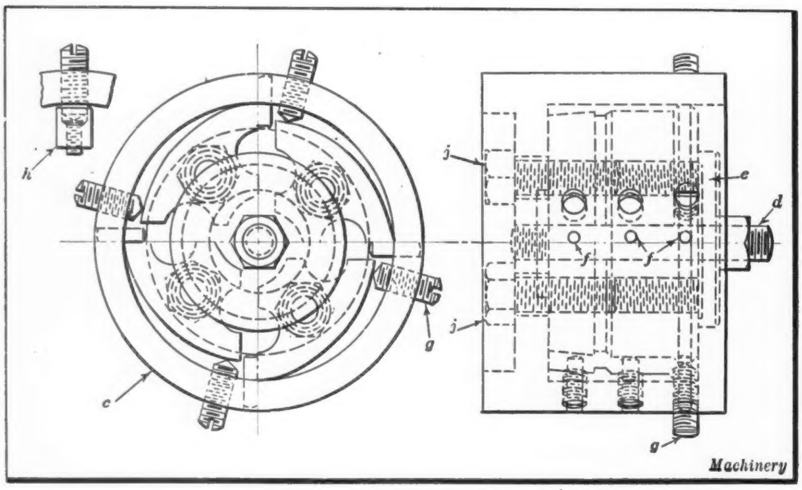


Fig. 3. Fixture for assembling Formed Cutter

tool steel. The diameter of the hole bored in the blank should be approximately the same as the diameter of the milling machine spindle. In other respects the blank is made the same as the form tool for a screw machine. Where there is a considerable difference between the various diameters on the part to be formed and where accuracy is required, the amount of radial difference should be calculated in the same manner as in the case of circular formed tools by employing the formula given on page 826 of the fifth edition of MACHINERY'S HANDBOOK and on page 893 of the sixth revised edition.

Before the finished blank is removed from the lathe, two circles indicating the screw-hole and the key-hole centers should be drawn on one face. The screw-holes are next drilled and tapped, after which the blank is taken to the milling machine where it is cut into quarters. The four pieces thus obtained are clamped together as shown at *B*, Fig. 2, and the four key-holes *a* drilled. The two end flanges *b* (view *C*) are made from cold-rolled stock; they are bored out to fit the milling machine spindle and have four drilled holes that match the tapped holes in the four sections of the cutter. The holes in the plates are made about 1/16 inch larger than the cap-screws used to secure them to the cutter blades.

Assembling the Cutter

The cutter must be assembled with care, for upon this operation depends the success of the tool. While it can be done without special means, the assembling jig designed for this purpose, which is shown in Fig. 3, is of great assistance, especially when several cutters are to be made. This fixture consists of a cup-shaped piece *c* having an internal diameter equal to the largest diameter of the finished cutters, with a central clamping stud *d* and plate *e* which serve to hold the pieces in position for adjusting. Four holes are drilled in the recessed bottom of the cup at points corresponding to the location of the screw-holes in the flanges and the cutter sections.

To locate the cutter sections accurately and automatically give them the proper amount of rake, four rows of locating pins *f* and spacing screws *g* are let into the cylindrical wall of the jig. The number of sets of pins and screws used must be determined by the judgment of the workman. It was found by experiment that a rake of about 8 1/2 per cent proved satisfactory in this case. The cup-shaped gage *h* shown in the upper left-hand corner of Fig. 3 is used in setting the rake screws to a uniform depth.

After the cutter sections have been put in place in the assembling jig, the clamping plate is lightly tightened down and the sections pushed around until each comes in contact with its respective locating pin and screw. The clamping plate is then firmly tightened, and the sections locked to the bottom of the cup with four cap-screws *j*. The center stud and the clamp is then removed, and the jig placed on the left faceplate, where it is trued up and the center hole bored out to the exact size required.

After heat-treatment, the pieces are again assembled in the jig in the same manner as before, except that the end flanges are included in the assembly. When the pieces have been located and securely locked in place, a pin of the same diameter as the milling machine spindle is substituted for the center clamp, and one of the end flanges is tightened down firmly on the four pieces, the flange being centered by the pin. After this has been done, the assembly can be removed from the jig and the opposite end flange secured in place. Babbitt is then poured into the tool to lock the blades in place. A hard grade of babbitt should be used and the tool should be slightly and uniformly warmed before the pouring is done. This completes the cutter except for the light grinding cut taken to sharpen the teeth. Cutters of this type have been found to stand up well in use, and no difficulty has been experienced from the teeth loosening, even when heavy cuts are taken.

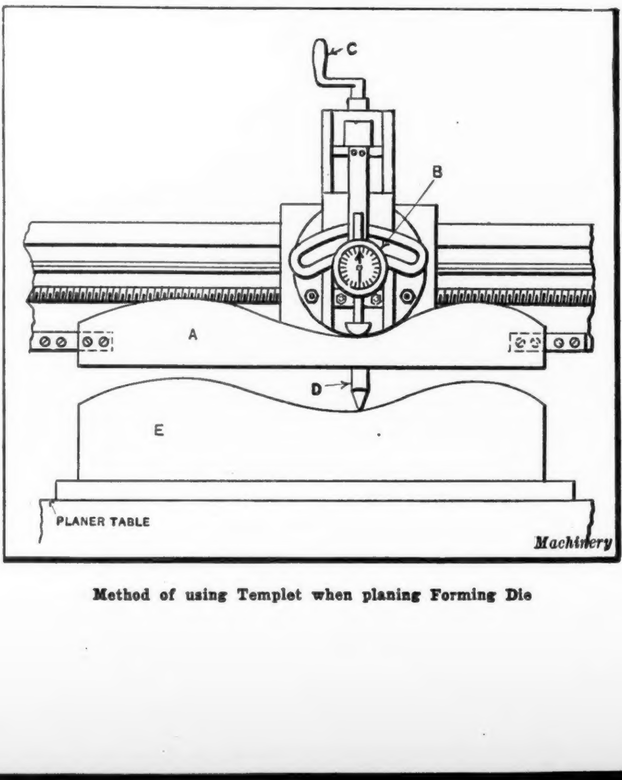
* * *

PLANING FORMING DIES

By CHARLES KUGLER

The method of using a templet, as shown in the accompanying illustration, to guide the tool when planing forming dies was employed in a small contract shop engaged in the production of dies for automobile body work. Before this method came into use, it was the practice to grind, file, and scrape the dies to fit the profile of a templet. Referring to the illustration, *A* is a templet which is fastened to the cross-rail of the planer. The dial indicator *B* is secured to the planer head ways. By using a fine feed and controlling the up and down movement of the cutting tool with handle *C* in such a manner that the indicator hand of the dial is kept on the zero mark, the tool *D* will plane the surface of the die *E* to correspond with the profile of the templet *A*.

A different templet must, of course, be used when planing the upper member of the die. The two templets are produced at the same time from a piece of sheet zinc about 1/32 inch thick. After scribing the outline of the die on the zinc plate, the scribing end of the dividers is ground flat and sharp like a knife. By pressing down hard on the dividers the metal can be creased quite deeply along the scribed outline. When this has been done, it is an easy matter to break the metal along the outline, thus producing the templets for both the upper and lower die members.



Method of using Templet when planing Forming Die

Oil-ring Design

By HERBERT A. FREEMAN

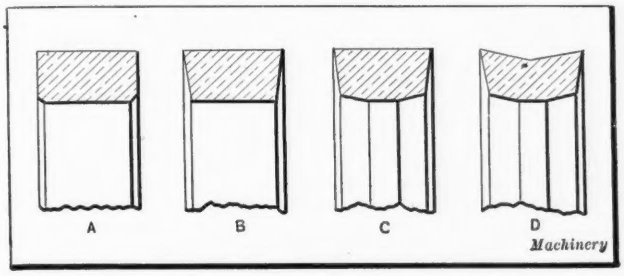


Fig. 1. Oil-rings with Different Shaped Cross-sections

ALTHOUGH many phases of oil-ring bearing design have been dealt with in the technical press, little or nothing has been published regarding the oil-ring itself. The oil-ring is an important adjunct of this type of bearing, and it is the object of this article to present data on the design of oil-rings that have given good service.

A weak point in an oil-ring-lubricated journal is that it must be started dry or nearly dry. Hence, an oil-ring should be so designed that it will start promptly when the shaft begins to rotate. When a machine has been standing idle for a time, the film of oil between the journal and box becomes so attenuated that there is actual metal-to-metal contact at some points on the bearing surface. Under this condition, the initial bearing friction on such machines as large synchronous motors is so great that it is more economical to install force-feed lubricating equipment, with its complicated auxiliaries, for use when the machine is started, than it would be to use the larger and more expensive starting compensator that would be required to overcome the high friction of rest when the bearings are lubricated solely by the oil-ring system. This high static friction causes heat and wear, and the shorter the period of its existence, the longer will be the life of the bearing.

After the ring has once started, it should continue to rotate as long as the shaft turns. On a poorly designed bearing, it is not uncommon to see a ring start, stop, and repeat this action in regular cycles. At the instant of starting, there is actual metal-to-metal contact between the ring and shaft, with the coefficient of friction fairly high. When the oil gets on the ring, the coefficient of friction drops rapidly, but it should still remain high enough to rotate the ring in a positive manner. Other causes of rings sticking are unbalance in the rings due to blow-holes, lumps of solder, unsymmetrical design, or egg-shaped rings. The oil-ring should not race. When it does this, it is likely to pump oil out of the cellar through the oil gage, if the latter is of the open type. The lubricant then finds its way down the pedestal to the floor, making an unsightly and wasteful mess.

Diameter and Weight of Ring

As a general rule, the oil-ring should be made at least twice the diameter of the shaft. The oil cellar should be so proportioned and the oil overflow so located that, with a maximum oil level, the ring will dip into the oil to a depth equal to about one-third the diameter of the shaft. The area of the cross-section of the ring is determined as much by machining and handling considerations as anything. The best up-to-date practice tends toward the use of heavy rings. A ring that is heavy enough to stand up under production cuts and to undergo rough handling in the stock-room and at the assembly bench without becoming distorted will be sufficiently heavy for duty in the average bearing.

Material for Oil-rings

A fairly hard brass is a desirable material for small and medium sized rings. The writer has also used cast iron with success, but this is not generally favored. It is claimed that washers of sheet metal, several of them running in one ring slot, have given satisfactory results. Very soft compositions or dead soft brass should be avoided, for if the oil becomes gritty, the rings will be charged like a lap, and will wear grooves in the journal. Although it seems incredible, the writer has seen shafts that were grooved to a depth of 1/8 inch from this cause by a ring weighing only a few ounces. As an experiment, a ring about 2 1/2 inches in diameter and perhaps 3/16 inch wide, which had grooved a bearing badly, was put on a hardened half-inch arbor mounted in a bench lathe. By rotating the arbor rapidly and turning the ring slowly with a slight pressure at one point on the arbor, and keeping it wet with oil taken from the cellar of the bearing in question, a groove was soon worn in the arbor that could be detected or measured with a vernier caliper.

Cross-sectional Shape of Rings

The cross-sectional shape of the ring is important. A plain rectangular cross-section, such as shown at *A*, Fig. 1, is often used. Rings of this kind can be easily machined from tubing, and if care is taken to keep the tools sharp and to feed back, from the inside of the tube, no further machining of the sides is necessary. The stock should also be kept concentric with the spindle of the machine, otherwise the chuck jaws may jam the tube out of round and even if they do not, the ring will be elliptical instead of circular and will tend to stick when used in a bearing.

Rings made of the larger sizes of tubing can be cut off in a pipe cutting-off machine. The larger rings can also be made from pot castings provided with lugs for bolting them to the faceplate, as shown in Fig. 2 at *G*, or the lugs may be omitted and the pot casting held in a three-jaw chuck. The butt left in the chuck generally weighs more than that left when the lug construction is used, and there is slight chance of springing the pot with the latter construction. On the other hand, the pot castings can be more easily and quickly

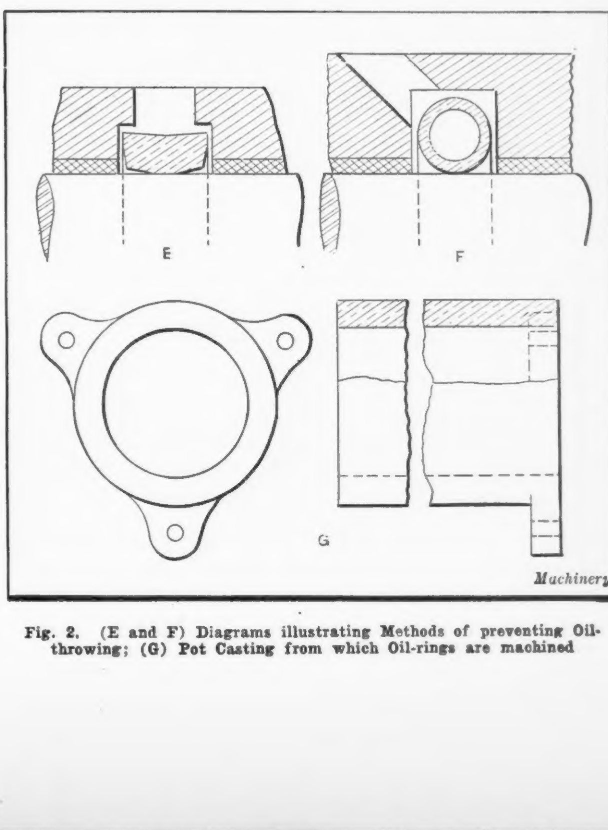


Fig. 2. (E and F) Diagrams illustrating Methods of preventing Oil-throwing; (G) Pot Casting from which Oil-rings are machined

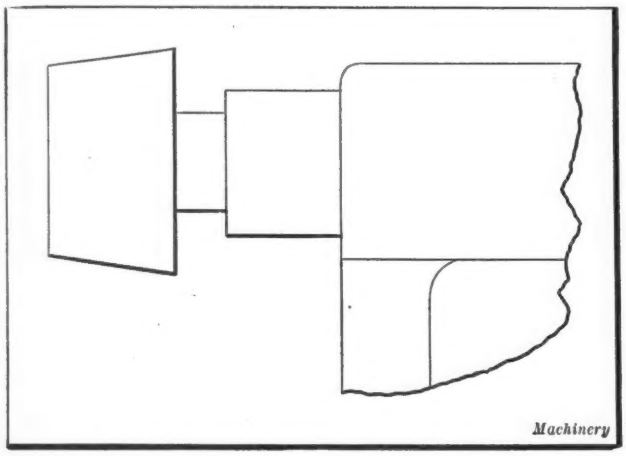


Fig. 3. Tailstock Plug for Use in lining up Pot Casting in Lathe

chucked with the jaw chuck and less metal is required for finishing.

A conical-ended plug similar to that shown in Fig. 3 is sometimes an aid in chucking. This plug is held in the tailstock spindle or the turret of a turret lathe, and when the work is chucked, it is run into the hole in the pot casting to steady and roughly center the free end. After the casting is securely fastened, the plug is backed out of the way. The chief advantage in using pot castings is that the periphery of the ring may be kept circular much more easily. The principal objection to cast material is the possibility of hidden blow-holes which throw the rings out of balance. Inspection methods to guard against this trouble, such as trying rings on a perfectly level surface plate, are both tedious and expensive.

A better shape than the rectangle for the cross-section of an oil-ring is the trapezoid shown at *B* in Fig. 1. As will be shown later in the article, it is sometimes necessary to have a ring fit the slot rather closely, and this shaped ring is less likely to bind in the slot if the machine happens to be a little out of level axially. A further refinement may be made by chamfering the bore as at *C*. For small light rings, this is particularly good, as it increases the specific pressure between the shaft and ring, thus enabling the ring, even though light in weight, to cut through the oil and get a better bite on the shaft.

Large rings are sometimes made by winding a strip of brass on an arbor, the same as when forming a closed coil spring, and then slitting this coiled strip with a saw. After the ends of each coil are joined by brazing and sweating, the rings thus formed may be machined to any cross-sectional shape desired, although it is not so easy to have their periphery circular when they come out of the chuck as might at first appear. Round rod and tubing can also be used for rings made in this manner.

The number of oil-rings used on a bearing is not determined by hard and fast rules. One ring will usually supply all the oil necessary for lubrication. Additional rings, in most cases, are merely insurance against bearing failure in case one ring sticks. Sometimes two rings are run in one slot. In one arrangement of this kind that came to the writer's attention, the rings were of different diameters, a feature for which there seems to be no good reason. Possibly it was merely a mistake in assembling.

Position of Rings on Bearings

Exact positioning of the rings on the bearing seems to be of little moment, provided they are on the middle third part of the bearing. Positioning, as regards the supports for the bearing, however, is important. Rings should never be located between the bearing support and the inboard end of the journal box, if it can be avoided, as oil is almost sure to be sucked into the machine with this arrangement.

For bearings running at speeds of less than 300 feet per minute and up to 200 revolutions per minute, the ring of circular cross-section seems to be as good as any. There is theoretically a point contact between the ring and shaft and a correspondingly high specific pressure. For a given weight, a ring of circular cross-section has the least area of wet surface when dipping a given depth into the oil. The counter-torque caused by the viscosity of the oil is therefore the least with this shape of ring, and as would be expected it has proved to be the most positive in action.

In the case of low-velocity bearings, the importance of having the ring in balance, as well as having its periphery a true circle, cannot be over-emphasized. If the ring is hollow, tubing being used instead of solid rod, care should be taken, in soldering the ends together, not to get a lump of solder into the tube, as it will throw the ring out of balance and often cause it to stick. The safest way to solder rings of this kind is to tin the ends and then sweat them together, or else use solder rolled into foil, and when soldering, spring the foil between the ends of the ring. The amount of solder that gets into the tube by this method is too small to cause trouble.

Preventing Oil-throwing

Most bearings running at from 200 to 2000 revolutions per minute are fairly easy to take care of if the rubbing speeds are under 2000 feet per minute. For higher speeds, difficulties are likely to be encountered. The ring must not only carry an abundance of oil, but must do so without throwing any oil from its rapidly revolving surface. It must prevent the oil, which is escaping at high speed and pressure from the bearing, from being thrown out into the ring slot and thence into the room.

A ring of circular cross-section, a T-section with the stem of the T away from the shaft, a triangular section, or in fact, any section having a projection along the middle of the ring will permit oil to work out to this projecting edge, from which it will be thrown out of the pedestal if the peep-holes are within range. A circular ring, in particular, is very likely to race at high speeds and throw oil badly. The tendency may be counteracted to a degree by having the oil-ring peep-hole positioned as shown at *F* in Fig. 2. The contour of the cross-section shown at *D*, Fig. 1, effectively prevents oil-throwing of this nature. The oil collects at the two outer edges, and when thrown off, strikes the sides of the oil-ring slot, which prevent it from leaving the pedestal. If the bearing is split, the slot may have projecting sides as shown at *E*, Fig. 2, and the spatter from the rings striking these projecting lips will run back into the cellar.

Controlling Action of Oil-rings

To prevent a too rapid movement of the ring and to cut down the amount of oil that the ring carries, the oil-ring slot may be tapered as shown in Fig. 4. The clearance between the oil-ring and the slot should be from 0.020 inch to 0.040 inch for an angular distance of about 15 degrees, and then widen out to three or four times this amount for the remainder of the slot. The oil carried up by the ring col-

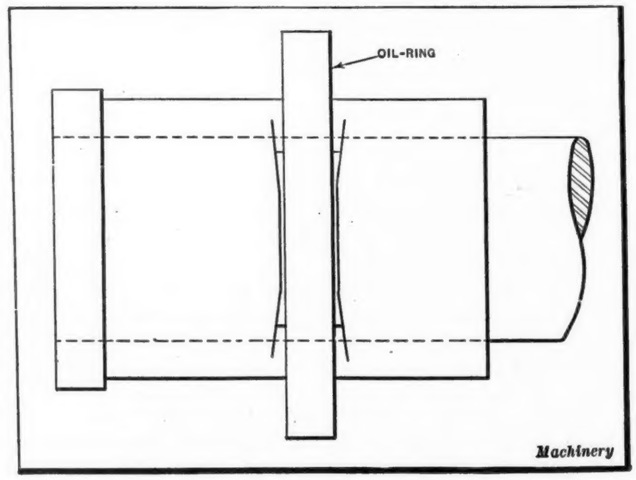


Fig. 4. Tapered Oil-ring Groove that retards Speed of Ring

lects in the tapered portion of the slot and, acting as a sort of wedge, makes quite an effective brake for the ring. The close-fitting sides of the slot act as knives to shave off a thick layer of oil and return it to the oil well without the formation of foam. Too violent a movement of the oil causes foam to form on the surface and creates an artificial level in the oil gage, and sometimes causes oil to pump out of the nose of the bearing.

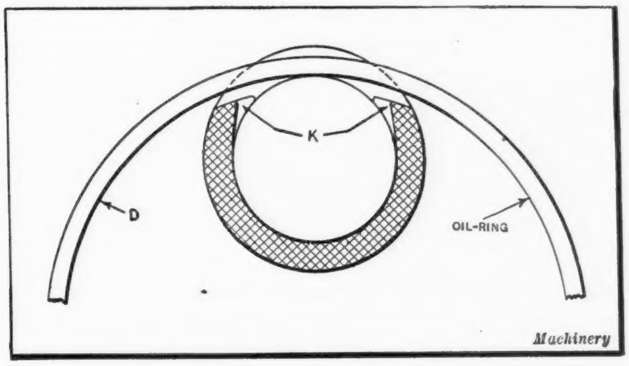


Fig. 5. Bearing with Pockets at Ends of Oil-groove that prevent Oil Atomization

If the rings are removed from a high-speed bearing and the lubricant is supplied in some other manner, it will be noticed that small drops of oil fly with great velocity out of the bearing into the oil-ring slot. At bearing speeds of 3000 feet per minute and over, this becomes a minutely atomized spray or mist which floats in the air like a fog. The ring *D*, Fig. 1, in conjunction with two small pockets at the ends of the oil-ring slot, as shown at *K*, Fig. 5, will be found very effective in eliminating this fog. The oil accumulating in these pockets, together with the sheet of oil flowing from the edges of the ring, forms a very effective damping means. When rings are so positioned in the bearing that they are difficult to inspect, it is good practice to give them a few stripes of light-colored oil-proof paint, like a barber's pole, so one can easily see if they are turning properly.

Methods of Joining Ring Ends

In general, all split bearings should be provided with split oil-rings. A ring of this kind that has proved completely satisfactory to the engineering department, the shop, salesman, and customer has not yet been devised. Among other requirements it should be easy to manufacture in small or large lots, not easily distorted, as free as possible from soldered-on parts, capable of being made without excessive waste of material, free from flaws that tend to throw it out of balance or cause it to catch, easily unfastened or securely fastened, and not fastened with small loose pieces that are likely to fall from a man's hands into a cellar full of oil.

Rings that have given good results are shown in Figs. 6, 7, and 8. At *L* are shown the joints at opposite sides of one type of ring. At *M* is shown a method of fastening that has proved particularly good for small thin rings not having stock enough to permit axial holes. The rings are turned, and at opposite positions on their peripheries grooves are milled which are slightly narrower than the ring. Pin-holes are drilled, and the rings are then split and fastening pins sweated into one half, while strips of spring brass, carefully fitted into the milled grooves, are sweated into the other half with low melting point solder, after which the strips are riveted in place.

A composite ring built up of brass angles placed back to back and assembled with a lap joint is shown in Fig. 7 at *N*. Drawn brass angles of suitable size for this purpose are a commercial article. The small fastening screws tapped into the ring are better than a bolt and nut arrangement, since there are no nuts that may be lost in the oil well. The ring shown at *O* represents a composite construction of brass angles and a central flat disk or ring. These units are so fastened together that the ends of the central ring at the joints are dovetailed between the angles, while fingers punched from the legs of the angles engaging oblong slots in the central ring serve as a means of aligning and fastening. Made in quantities, this is a fairly cheap ring which has the merit of being free from all loose or sweated-on parts.

The illustration at *P*, Fig. 8, is self-explanatory, the novelty being the fastening pin, which is a U-shaped piece of wire, easily replaceable if lost. Recesses for the pin are either counterbored or milled in the sides of the ring, so that the wire need not project if put in place properly. At *R* is shown a simple arrangement for a tubular ring. The locking means is a curved bolt, which conforms to an arc of the same circle as the hole in the bent tubing. It is round in cross-section and has a depression drilled in it for the insertion of a screwdriver, with which it may be easily pushed into place. The bolt, can of course, be made out of tubing also. One half of the oil-ring has its end slit, as shown, to permit the bolt to be pushed into place with the screwdriver. Should the bolt become too loose, a little judicious peening will bring it back to a neat fit.

A scheme said to be used successfully in one shop, which the writer intends to try out some time, is to have a dove-

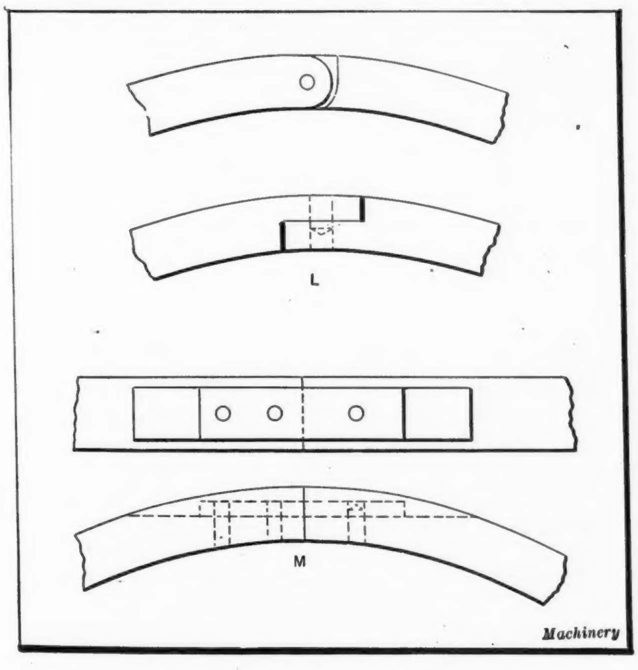


Fig. 6. Method of joining Oil-ring Ends

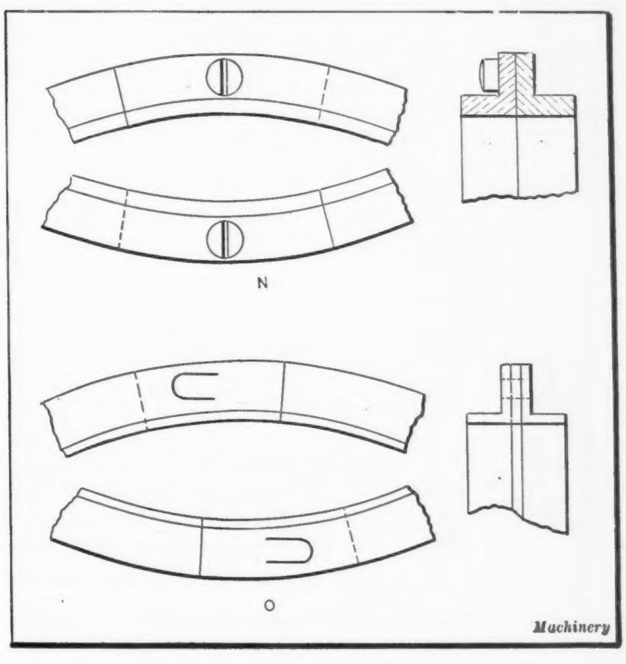


Fig. 7. Two Styles of Built-up Oil-rings

tail turned in the outside of an oil-ring, care being taken to get a good smooth surface free from feed lines or chatter marks. This surface is then well smoked and cast full of type metal. If properly done, it is said that the type-metal ring, when cool, will have a sliding fit on the inner brass ring. After any necessary trimming is done, the rings are sawed apart, taking as small a kerf as possible. When assembled on the shaft, the inner ring is slipped around a few degrees, thus locking the halves securely together.

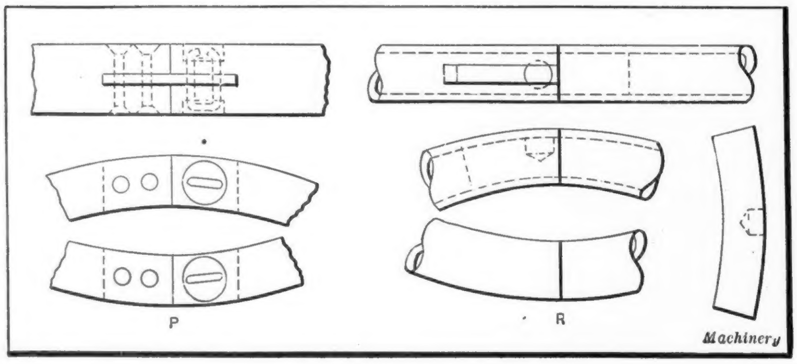


Fig. 8. Other Methods of securing Oil-ring Ends

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AUTOMOBILE PRODUCTION

It is estimated that the German production of automobiles reaches from 30,000 to 40,000 cars annually. Italy produces from 50,000 to 60,000 cars, England about 100,000 cars, and France from 100,000 to 150,000 cars. Only the United States has accurate statistics in regard to automobile output. From the figures given in the foregoing it will be seen that even if we accept the highest estimates for the countries given, the United States produces approximately ten times as many automobiles as England, France, Italy, and Germany together. In fact, our exports reach nearly the total of the production of all the countries mentioned. Ford alone builds about five times as many cars as are built in all Europe. According to statistics published by the National Automobile Chamber of Commerce, the number of motor vehicles exported from the United States in 1924 was 380,000, with a valuation of about $265,000,000. The exports amounted to about 10 per cent of the total production; the number exported in 1924 showed an increase of 15 per cent over 1923. It is interesting to note that only 745 motor vehicles were imported last year.

One of the interesting phases of the automobile industry is the rapid growth of the motor bus business. At present the annual production of motor buses amounts to about 10,000. Thirty-three railroads use motor trucks as part of their freight shipping service, and 174 railroads use motor vehicles on short lines for passenger service. There are 2500 motor buses used by street railway corporations, 168 different street railway systems making use of the motor bus to amplify its service. Motor travel is also playing a large part in the building up of consolidated rural schools in the United States. In this service, 19,656 motor buses are used.

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RESEARCH FELLOWSHIPS IN METALLURGY

Four Research Fellowships in metallurgy are being offered for the next academic year at the Carnegie Institute of Technology and the Pittsburg Experiment Station of the United States Bureau of Mines. The work of the research fellows will cover a period of ten months; starting August 17 this year. Each fellowship carries a stipend of $750, in addition to a remission of the usual tuition fee. Applicants must have a thorough training in chemistry, physics, and fundamental engineering subjects. For further information those interested should apply to the Carnegie Institute of Technology, Pittsburg, Pa.

* * *

American exports of industrial machinery to Italy, according to *Commerce Reports*, increased materially during 1924—approximately 75 per cent. The leading factors in this gain are the increased purchases of mining, oil well, and pumping machinery. There has also been a material increase in the imports of metal-working machinery, especially grinding machines. While the total exports of metal-working machinery to Italy in 1922 was valued at only $82,000, and in 1923 at $142,000, the exports in the first nine months of 1924 amounted to $230,000. Of these exports, grinding machinery represented a value of nearly $60,000, and gear-cutting machinery, $18,600. During the same period in 1924, metal-working machinery of all kinds was exported to Great Britain to a value of $2,269,000, a gain of 22 per cent over the same period in 1923.

PRIZE COMPETITION

MACHINERY offers five prizes for the best

Tables Suitable for Data Sheets

The tables submitted in this competition should be of practical application in the design and construction of machinery, or of general value in the machine shop industry; they should be as broad in their application as possible and not confined to special practice in a single plant; they must have been actually used in some branch of the industry; and should not be generally available in handbooks or works of reference.

In awarding the prizes, the value of the tables submitted will be estimated in accordance with the conditions outlined above; the care with which the tables have been prepared and their adaptability to MACHINERY'S standard data sheets will also be considered.

A single data sheet or a set of sheets may be submitted. Each contestant may enter tables in the competition on as many different subjects as he wishes, but a prize will be awarded for one subject only. However, if the tables on additional subjects submitted are accepted for publication, they will be paid for at regular space rates.

For the best data sheets or sets of sheets MACHINERY will award five prizes:

One first prize—Fifty Dollars cash.

Two second prizes—each prize MACHINERY'S Encyclopedia in seven volumes.

Two third prizes—each prize, ten volumes of MACHINERY'S Mechanical Library.

The winner may select from the twenty-nine volumes of the library the titles he prefers. Should a winner of MACHINERY'S Encyclopedia already own this work, he may select instead any fifteen volumes from the Mechanical Library.

All tables for this competition must be in the hands of the Editor of MACHINERY, 148 Lafayette St., New York City, on or before July 1, 1925. Any tabular matter submitted that is not accepted for publication will be returned.

Foreign Trade in Metal-working Machinery

Prepared by the Industrial Machinery Division of the Department of Commerce

AMERICAN exports of metal-working machinery to all countries amounted to $14,589,511 in 1924, according to statistics compiled from U. S. customs returns, representing an increase of over 20 per cent in comparison with 1922, and of approximately 8 per cent over 1923. Although the foreign demand for American machine tools may never again equal that experienced during war years, the increase in this trade since 1921 is highly satisfactory, especially when it is recalled that European competition has been particularly vigorous for the last three years.

Exports of metal-working machinery from the United States to Europe (except the Balkans) last year amounted to $7,350,146 or slightly more than 50 per cent of the total, and in 1923 to $4,853,729—representing an increase of 52 per cent. Practically every country in Europe, with the exception of Belgium, showed decided increases in machine tool purchases from the United States last year. Exports of this equipment to France nearly doubled in 1924, and Germany's purchases gained by an amount well over 100 per cent.

UNITED STATES EXPORTS OF METAL-WORKING MACHINERY

Destination	1924		1923	
	Rank	Value	Rank	Value
United Kingdom	1	$3,128,208	2	$2,451,499
France	2	2,058,521	4	1,091,967
Japan	3	1,981,033	3	1,484,618
Canada	4	1,751,892	1	2,956,589
Australia	5	639,749	6	638,618
Germany	6	545,315	11	209,474
Mexico	7	352,279	7	585,728
Cuba	8	345,761	8	382,640
British India	9	336,914	5	717,757
Spain	10	324,020	9	280,350
Italy	11	304,376	15	142,263
Russia in Europe	12	227,972	..	......
British South Africa	13	222,765	16	139,353
Argentina	14	214,889	12	204,321
Chile	15	213,494	14	187,977
Netherlands	16	201,532	17	123,859
Belgium	17	192,488	10	220,680
Brazil	18	187,082	13	199,889
Sweden	19	155,492	18	111,591
Peru	20	119,749	20	79,011
New Zealand	21	106,686	19	85,962
Total to all countries	$14,589,511		$13,104,586	

Both Spain and Italy also showed an expanding market for American metal-working machinery last year, trade with the former increasing 17 per cent over 1923, and with the latter nearly 115 per cent. Last year Russia bought metal-working machinery valued at $227,972 from the United States, as against less than $3,000 worth in both 1922 and 1923.

Practically every South American country, with the exception of Brazil, absorbed larger quantities of American machine tools in 1924 than in the preceding year. Trade with South America as a whole showed a satisfactory recovery after the slight decline in 1923 in comparison with 1922—metal-working machinery exports amounting to $940,515 in 1924, as against $852,927 in 1923 and $857,377 in 1922. Considering the Latin American market as a whole, a decrease in exports amounting to approximately 7 per cent occurred last year, declines in the West Indian and Central American markets more than offsetting the gain made in South America.

Asia bought American metal-working machinery valued at $2,386,220 in 1923, and $2,580,792 worth in 1924—a gain of less than 1 per cent. Practically every Asiatic market, with the exception of Japan, the Philippines, and the Dutch East Indies, showed declines in American machine tool purchases last year. The gains made in those markets, however, slightly more than offset declines in exports to China and British India. Exports of metal-working machinery to British India declined from $717,757 in 1923 to $336,914 in 1924, and to China from $76,095 in 1923 to $51,345 last year.

Shipments of machine tools to Africa from the United States last year amounted to $247,599, and in 1923 to $158,982. This gain is obviously due to the increased demand for industrial equipmet in British South Africa—the most important market on the continent. Trade with Australasia last year also showed an increase in value of equipment exported, but a decline of about one-half of one per cent in percentage of total metal-working machinery exports last year, as compared with 1923.

Great Britain ranked second as a purchaser of American metal-working machinery in 1922 and 1923. Last year England ranked first, buying $3,128,208 worth of this equipment. France rose from fourth place in 1923 to second in 1924 with machine tool purchases amounting to $2,058,521. A feature of last year's trade was the decline in exports of this equipment to Canada—$1,751,892 worth, a reduction of more than $1,000,000, as compared with the 1923 figure. The accompanying table gives American exports of metal-working machinery to the twenty-one leading markets of the world.

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ELECTRON METAL

Electron metal, the lightest constructional metal in existence, was first placed on the market in 1909 by the Griesheim-Elektron works in Germany. It is an alloy of magnesium, having a specific gravity but two-thirds that of aluminum, with great tensile strength and machineability. The fact that it contained magnesium caused much prejudice against its use at first, most people only knowing that metal in the shape of wire or powder of great combustibility. It is true that electron metal, after melting, is very oxidizable, its blinding white light being characteristic, but, as its melting point is as high as that of aluminum—about 1200 degrees F.—its combustibility need not be considered unless the metal is to be used under exceptional conditions as to temperature. Of this the greatest proof is afforded by its use in internal-combustion engine pistons, where it is constantly exposed to the exploding gases. Its chemical character restricts its sphere of application, being unsuitable for articles which are in constant contact with running water, acids, or acid solutions. When exposed to the atmosphere, a gray coating of rust forms, but this coating does not, like iron rust, extend further into the metal, which is, in the case of electron metal, saved from further attack. The application of oil or grease entirely prevents the formation of such a coating.

According to an article in *Bergwerks Zeitung*, great difficulties had to be overcome before it was possible to cast the metal, since liquid magnesium reacts explosively with water. Green sand casting was therefore out of the question, and all molds had to be baked to drive off every trace of moisture. Baked molds, however, are expensive and delicate to handle, besides being so dense as to prevent the contraction of the metal. About three years ago the works referred to above, patented covering substances which, mixed with the sand, prevented any reaction between water and the liquid metal.

Current Editorial Comment

in the Machine-building and Kindred Industries

A NEW LABOR PROBLEM

The highly productive machine tools developed during recent years have created a new problem in the machinery industries. These machines are labor-saving, it is true, in so far as they produce great quantities of work with a minimum amount of labor per piece. But they produce an incomparably greater number of pieces in a given time, so that the labor required of the *operator* attending the machine is by no means reduced. On the contrary, he often has to work harder than ever. The mere picking up of work to be placed in the machine, clamping and removing it, when the machine performs its operations at a rapid rate, places the operator under a heavy strain. The manager in an automobile plant recently stated the case in these words: "The solving of our production problem has created a new labor problem. In some instances the physical exertion required to lift heavy pieces and place them in these machines is so great that we have to select operators not because of their ability as machinists but because of their physical strength."

This condition will lead to another step in the design of machine tools. Work-tables will be lowered so that the work can be placed in the machine without too much lifting; conveyors will be used that will bring the work to the operator at the height of the work-table; lifting appliances will be provided for placing the work in the machine; and frequently loading facilities will be made part of the design.

When Ford raised the wages of his machine operators some years ago above the general level of wages in Detroit, his purpose was doubtless to reduce the labor turnover in the Ford plant. The high-production machinery that he began to install at that time forced his men to work unusually hard, and an added inducement was required for them to put forth the necessary extra effort. Practically all automobile plants now are operated by similar high-pressure methods, and consequently the wages in all of them are practically alike. The installation of labor-saving machinery does not mean that the operator's work is lighter, but that his earning capacity is greatly increased, especially on a piece-work basis. The increased production warrants paying him well for the extra effort put forth.

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COMMERCIAL LIMITATIONS OF SPECIAL MACHINES

Although the expression "mechanical age" is often applied to the present period, there are, and doubtless will continue to be, many limitations in the use of mechanical labor-saving devices. Mechanical possibilities are practically limitless if we consider only the application of mechanism. But mechanical developments must necessarily be restricted by their cost, although this fact is frequently overlooked. If it were not for the economic factor, it would be possible to accomplish almost everything by mechanical means.

In considering very special equipment for use in manufacturing, we find in some instances that a special machine is practicable from the mechanical viewpoint, but entirely impracticable when the cost of designing and building and, perhaps, of maintaining, is taken into account. Then there is another general class of special equipment which may be built to advantage for the manufacturer's own use, but which could not profitably be placed upon the market. A business is sometimes founded upon the invention or design of machinery which either gives the manufacturer a decided advantage over competitors or makes possible the fabrication of some product not previously marketed. Naturally such special apparatus is not made for the use of others. Even if the sale of certain kinds of special equipment were not inadvisable because of competition, the limited demand often prevents placing such appliances on the market.

These points have been emphasized, because inquiries are often received by MACHINERY about special equipment which is not for sale because of the reasons mentioned. Many evidently are under the impression that it is possible to obtain machinery for making almost any kind of product, whereas frequently the only existing machines are those which one, or at most a few, important firms in a given line of manufacture, have developed for their own use.

* * *

THE OLD PLANER IS NO HUSTLER

Look into almost any machine shop and you will find that the planers are usually the oldest of the equipment. Why is it that manufacturers replace other types of machine tools long before they replace their planers?

Undoubtedly the planer is a machine that will continue to operate for many years, as compared with some other types of machines; but great advances have been made in planer design, and the planers thirty, forty and even fifty years old that may be seen about the shops cannot approach the producing capacity of modern machines. The former have neither the speed nor power, they cannot take the cuts of the new planers, and they waste time on the return strokes.

In one large plant we saw recently three old planers s-l-o-w-l-y functioning, as they had functioned for the preceding thirty or forty years, although one modern planer would now do the work of the three, replacing three men with one and saving two-thirds of the wage item in the operating cost. "It pays to replace" is fully as true of planers as of other types of machine tools.

* * *

A QUESTION OF VALUES

An old legend tells of an employer who paid his workmen according to their weight—the heavier the man the higher the wage. All were laborers, and size and brute strength only were desired. Eventually two men were hired for brain work; one was small and the other large, and again wages were fixed by the pound. Now it happened that the small man was prolific in originating valuable schemes and devices, but the large man sat dumb and utterly failed to produce. And so the hiring by the pound was abandoned.

When the reader turns over the pages in MACHINERY, he finds many machines and tools which *produce.* How do we appraise their true value? Let us consider a modern machine tool. If in determining its value, we merely consider the quantity of metal in it, the time required to build it, and the overhead—cost accounting factors—then the method of estimating value would be in principle somewhat akin to the by-the-pound basis of the legend.

The equipment of the machine-building industry is basic, for it reproduces the endless variety of mechanical apparatus which is so closely interwoven with the entire structure of modern life. These creative machines and tools were not born yesterday; most of them have been evolved slowly from crude beginnings, through years and even generations. They represent research, experiments, experience, costly preliminary designs, and tests. These are the factors which belong in an estimate of true value. What a highly developed machine saves today, tomorrow, and every day in comparison with less efficient equipment—that is the true index of value.

Machine Tool Builders' Spring Meeting

THE twenty-third Spring convention of the National Machine Tool Builders' Association was held at the Hotel Statler, Buffalo, April 29 to May 1. The first day was devoted entirely to committee meetings, the first regular session being held Thursday, April 30, when the president, O. B. Iles, of the International Machine Tool Co., Indianapolis, Ind., delivered his address and the reports of the general manager, the treasurer, the membership committee, and the code of ethics committee were received. In the afternoon of the same day, the three committees that have studied the possibilities of market research reported, and the subject "What Marketing Research Would be Valuable for the Industry?" was discussed. A paper prepared by E. P. Blanchard advertising manager of the Bullard Machine Tool Co., Bridgeport, Conn., was read on the subject, "What Can We Do to Improve the Advertising of the Industry?" The work of the advertising committee and what it has accomplished in industry advertising was also reviewed and discussed after the committee had presented its report.

Friday, May 1, Dean W. W. Charters, Professor of Marketing at the University of Pittsburg, read a paper on "The Training of Salesmen," which was followed by a discussion of the subject, "What Can be Done to Improve the Salesmanship of the Industry?" H. W. Dunbar, assistant sales manager of the Norton Co., Worcester, Mass., read a paper at the same session on "Advantages of the One-price Policy."

At the fourth and closing session, George Merryweather, president of the newly organized National Association of Machine Tool Dealers, read a paper on "Some Objectives of the National Association of Machine Tool Dealers," and C. F. Meyer, foreign sales manager of the Landis Machine Co., Waynesboro, Pa., read a paper on "Conditions in South America." This was followed by a general discussion of foreign trade problems and the re-establishment of agencies in Europe.

The General Manager's Report

In his report to the convention, Ernest F. DuBrul, general manager of the association, stated that there has been a steady improvement in the state of the machine tool business since last June, as indicated by statistical data, but production is still much below capacity. Those machine tool builders who have brought out new designs of marked superiority over older types have naturally had the larger share of the business—this business being mainly replacement orders from users that are able and willing to install modern machines to supersede obsolete types. It is evident that most of the present business should be replacement business, because there is no appreciable expansion in the machine shop field, except in isolated cases.

Referring to the work of the association during the last six months, Mr. DuBrul mentioned that in November a Western Sales Managers' Conference was held in Cincinnati, when machine tool exhibits, advertising, motor drives, obsolescence of patterns, and ways and means of improving salesmanship in the industry were among the questions discussed. Regional meetings have also been held in Rockford, Cincinnati, and Providence, with the president of the association, O. B. Iles, presiding. At these meetings much the same subjects as at the Sales Managers' Conference were discussed.

Need For Technical Research

The need for technical research was also emphasized by Mr. DuBrul. "The machine tool industry," he said, "could well profit from cooperative research that would solve some fundamental technical problems of interest to large groups of the industry. Some of these problems are too big for any one concern to handle. They involve questions of such general interest that no one manufacturer alone can be expected to shoulder a burden that should rest on the whole industry."

It was pointed out that use could be made of the research facilities already at hand in the well equipped laboratories of the universities in every state where a fair number of machine tools are made. In many states industry pays to support these laboratories through taxes, and the industries ought to make use of the facilities provided. Valuable experimental work would be executed merely for the asking in many cases, and in other instances small sums spent for equipment would make available much other equipment already provided. It is hoped to stimulate interest in this work by the appointment of a committee on technical research.

Value of Information on Improved Methods and Equipment

The association was also urged to make increased use of the channels provided through the mediums of technical journals for informing executives in all machine tool using industries of methods whereby production costs may be reduced and production increased. In spite of the higher costs incurred when using obsolete machine tools, it is found difficult to induce machine tool users to replace them. The machine tool salesman is frequently able to prove to the works manager and production engineer that there is real economy in buying new equipment, but no sales result, because the financial men do not approve of purchases of new machinery no matter how profitable it would prove in the long run. Only the right kind of publicity, coming from the heads of leading machine tool firms, would make it possible to reach the men ultimately responsible for the acquisition of new equipment.

The South American Market

In his address on South America, Mr. Meyer said that there are about as many opinions on industrial conditions in South America as individuals expressing themselves thereon. Even among those who have had an opportunity to study the ground personally, complete unity of thought is lacking. It depends largely upon the manner of penetration, the industries visited, individuals interviewed, and on the proper analysis of this multiplicity of data. His own investigations were limited principally to the Republic of Brazil, Uruguay, Argetina, Chile, and Peru. These countries are all important industrial markets.

Brazil has an area 200,000 square miles larger than that of the United States, excluding Alaska. It is formed of twenty states and one federal district, and has a population of over twenty million. It is looked upon as the coming industrial country of South America. Uruguay is about equal in size to the New England states. Its population is one and one quarter million, 350,000 of which live in Montevideo, the capital. This little country impresses one with an air of prosperity, solidity, and thrift. It appears to be entering upon an era of industrial development.

Argentina is the second largest political division of the continent, having an area more than one-third that of the United States, not including Alaska. It is claimed to have a population of eight millions, two million of whom live in Buenos Aires, the capital. It is the great wheat and cattle raising country of South America.

Chile has an area four times the area of New England. It has an estimated population of about three and one half millions. The coast line is about 2700 miles long—as far

as from Boston to Salt Lake City—and from 50 to 250 miles wide, with an average width of about 100 miles. Peru has an area about seven times the area of New England. The population is estimated at three and one half million people, a large proportion of whom are Indians and mixed races. The wealth of Peru is at present in her mines.

Important Users of Machine Tools

The railroads form an important part of the industries of South America. The railroad shops, as a rule, are well equipped and well managed. They absorb the usual line of machine tools employed in American railroad shops. The electric street railways also have excellent shops, which come in for their share of machine shop equipment. Then there are the arsenals and navy yards. These are small in the majority of cases, but nevertheless must be equipped with up-to-date machine tools. In Chile, the nitrate fields, and in Peru, the mines, absorb their share of machine shop equipment.

German Competition in South America

Both Argentina and Brazil have been flooded with German machine tools that were manufactured at a very low cost. These machines, as a rule, occupy prominent positions in the show rooms, while the American machine tools which the dealers are handling under exclusive agency arrangements, are placed in the background. Here one sees also German copies of well-known American machine tools. Many of these machines are being sold at prices ranging from 25 to 50 per cent below those of similar American machine tools. The German manufacturers also are offering unusual terms. The following examples were taken from invoices for goods sold by an importer to a customer in Brazil: One-third against sight draft attached to bill of lading; one-third in 120 days; one-third in 240 days. In another case, one-third in two months; one-third in four months; one-third in six months; all without interest. It will be understood why Brazil and Argentina have become known as price and term markets.

The South American Machine Tool Dealers

In order to understand more fully the South American markets, we must stop to consider the importation of machine tools from the dealer's viewpoint. When a machinery dealer imports a machine, he has an immediate outlay in cash to cover the duty and other expenses. This outlay is considerable and applies to goods shipped on consignment as well as on open account. Then, too, the interest rates in Brazil are high, the maximum being 12 per cent per year. These rates naturally restrict borrowing for ordinary business.

When a sale is once made, the dealer must give terms which are never less than 60 days and in some cases terms of 240 days must be extended. Thus a firm that is a perfectly good credit risk is unable to meet cash or sight draft terms from the manufacturer because of the lack of surplus capital. As the majority of the dealers in South American countries have little more than a sufficient working capital, they naturally look to the manufacturers for financial assistance. British, Belgian, and particularly German manufacturers have answered their call, while many of the American manufacturers still continue to quote their respective lines cash against shipping documents F.O.B. New York City. The usual terms asked for by the dealers of the South American countries are 100 days from the date of the arrival of the goods at the port of destination. This means that the manufacturer must wait from 150 to 175 days for his money.

There are more than enough responsible machinery dealers and importers in both Brazil and the Argentine who could market our respective lines for us without confliction, but at present, there are only a few who show any interest in American machine tools, because their show rooms are stocked with German goods. The majority of the dealers believe that the manufacturers of machine tools in Germany will be unable to maintain the low scale of prices indefinitely. They realize that conditions in that country are undergoing radical changes which have already had their effects on the cost of labor and materials. The prices of German machine tools are already showing an upward trend.

American Tools in the South American Market

During the war, when England and Germany were otherwise occupied and there was a considerable increase in the demand for American machine tools, a number of American manufacturers opened up branch offices in one or more of the South American cities. In the majority of cases, this was done on a very large scale, and with the slump that followed the Armistice, many were forced to close up shop and return home. With the signing of the Armistice, a movement was immediately started by England, Germany, and Switzerland as well as other European countries to reclaim this market which had been temporarily lost to them. The result of their activities is shown by an increase in the value of their exports and a corresponding decrease in the value of our own. But South America certainly offers a market for American machine tools, and are we to stand by and let our neighbors increase their export business when we can retain and even add to what we now have by exerting some real sales effort?

The Argentine market differs from all other markets in that its industries are divided into two distinct classes, namely the railroads and private plants. British capital controls about 85 per cent of the railroads of that country, and it is the policy of this group to purchase the majority of their equipment through their London offices. The local dealers cannot participate in this business. The only way to secure a share of the business of the British-owned railroads in the Argentine is to place the matter in the hands of some English firm or individual who is in close touch with the local officials and also known to the London offices of these railroads. The railroad shops form an important group of the industries of South America. They are patterned, as a rule, after the railroad shop of England. They are well designed, well equipped, and well managed. The engineers in charge know their business, and they are ever on the lookout for tools and equipment that will enable them to improve their methods or lower their manufacturing costs. When they are once convinced that a certain machine will save them money, the order is assured.

* * *

TRACTOR ENGINEERS' MEETING

The national tractor meeting was held at the Great Northern Hotel in Chicago, April 29 and 30, under the joint auspices of the Society of Agricultural Engineers and the Society of Automotive Engineers. The agricultural engineers held their sessions during the first day, and the automotive engineers discussed their problems on the second day. A series of motion pictures, showing the developments and applications of farm tractors, were exhibited. After the technical sessions, visits were made to the experimental farm of the International Harvester Co., at Hinsdale, Ill., and to the Samuel Insul Hawthorn Farm at Libertyville, Ill., where power-operated machinery in regular and experimental use was seen in action. The papers presented dealt with recent developments in production methods and equipment, the influence of tractor engine development on automobile truck and motor bus engine design, and various phases of the activities of the Ford Motor Co. in the tractor field.

* * *

An International Personnel Congress will be held at Flushing, Holland, at the Grand Hotel Brittannia, June 20 to 27. It is expected that a large number of industrial countries will be represented by delegates. Those interested in the conference may obtain more complete information from the Secretariate, M. L. Fledderus, Glass Works, Leerdam, Holland.

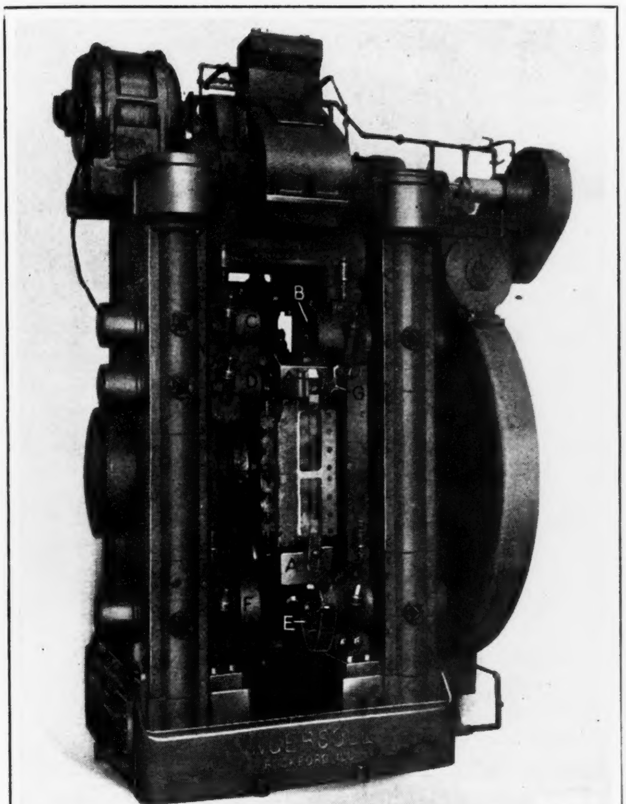

Fig. 1. Continuous Drum Type of Milling Machine for rough- and finish-milling the Top and Bottom of a Cylinder Block

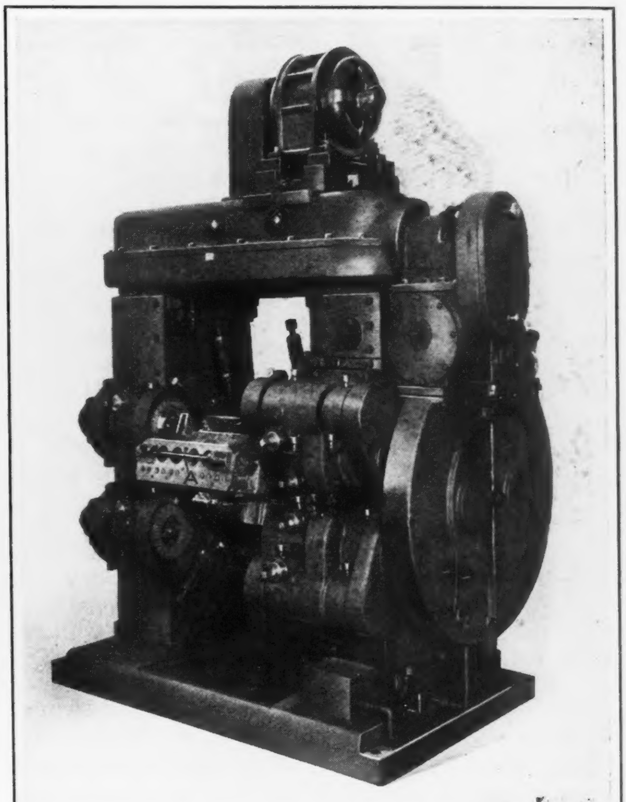

Fig. 2. Another Continuous Drum Type of Milling Machine employed for finishing the Ends of the Cylinder Block

Special Machines in an Automobile Plant

IN the production of a part of predetermined quality in large quantities, the use of machines newly installed for certain operations is often limited to some extent by preceding and succeeding operations performed on the older machines. The ideal condition is obtained when an entire line of new machines is installed, because then the various surfaces and holes of the work can be finished in the best sequence, and locating surfaces can be positioned where they will be most convenient for all operations. It is often desirable to modify the design of the work to suit the manufacturing processes, and this can be more conveniently done in planning an entire process. This ideal condition existed when the engineers of the Ingersoll Milling Machine Co., Rockford, Ill., were called upon to design twelve special machines for performing operations on automobile cylinder blocks, cylinder heads, and transmission cases. The important features regarding the application of these machines will be described in this article. All production figures given are based on a 90 per cent efficient operation of the machines.

The first operation on the cylinder block, with which the crankcase is cast integral, is performed on the machine illustrated in Fig. 3. The operation consists of finishing bosses that are used for locating purposes in subsequent operations. The machine is provided with two vertical and four horizontal cutter-spindles. The cylinder blocks are delivered to the machine by a roller conveyor, of which rollers *A* are a part. Each casting is pushed from these rollers into the fixture, and then handwheel *B* is turned to expand four locating points against the inside of the crankcase. Lever *C* is next lowered to push the casting back so that two additional locating points are passed through cored holes in the casting into contact with Nos. 2 and 5 cylinder barrels.

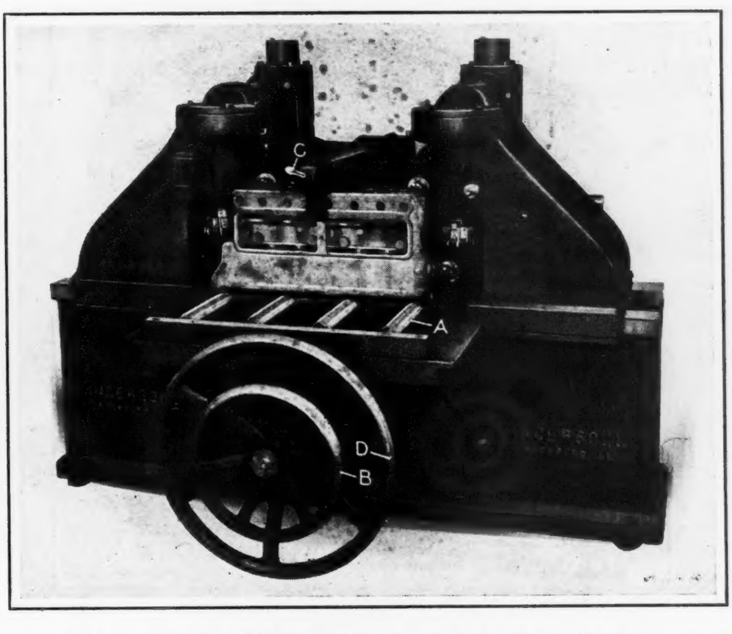

Fig. 3. Six-spindle Milling Machine used to finish the Locating Bosses

With the work held in this manner, handwheel *D* is turned to feed the cutters across the work, after which the handwheel is turned in the opposite direction to return the cutters to the starting position. On this job fifty castings are produced per hour. When the casting has been released from the fixture, it is pushed along the roller conveyor to the next machine. A conveyor system is used to carry the castings from machine to machine, so as to reduce manual labor and loss of time to a minimum.

Next in the order of the machining operations comes the milling of the top and bottom surfaces of the cylinder block. From Fig. 1 it

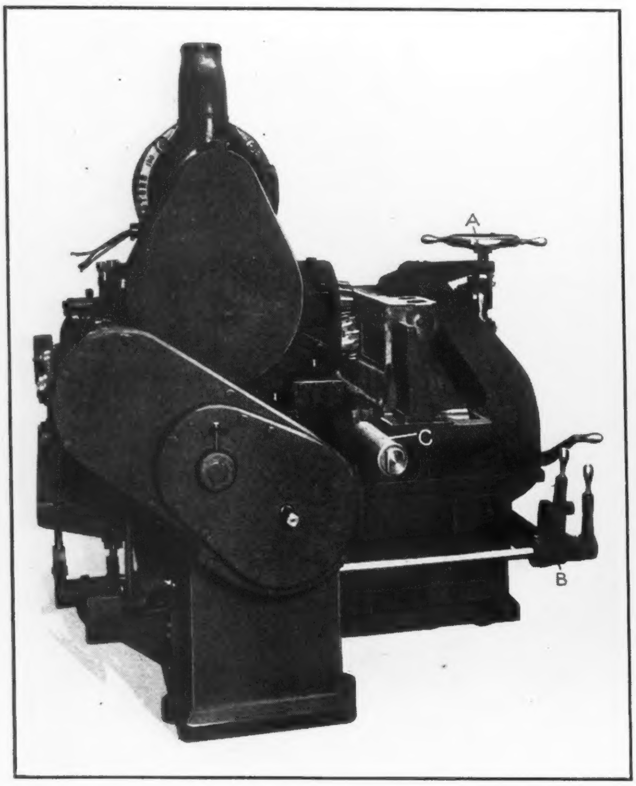

Fig. 4. Milling the Valve Cover Seat and the Manifold Pads on One Side of the Cylinder Block

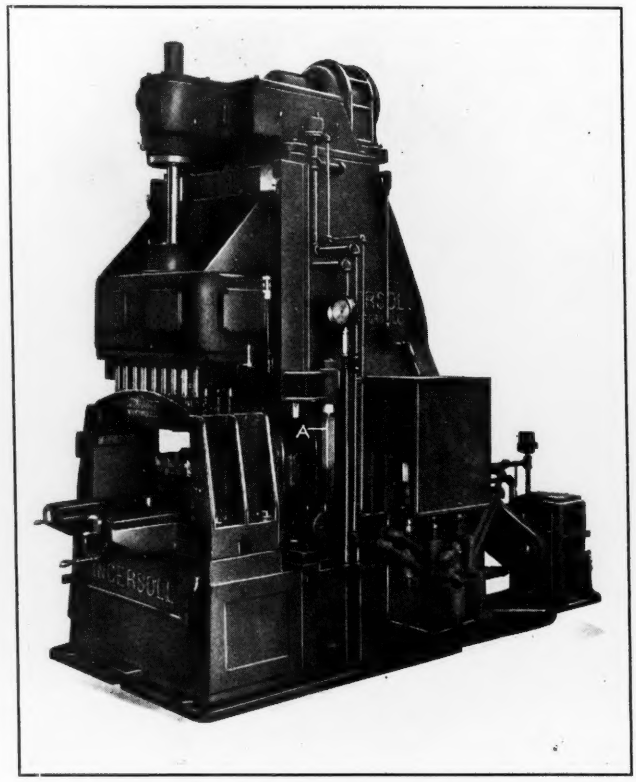

Fig. 5. Multiple-spindle Drilling Machine equipped with One Vertical and One Horizontal Head

will be seen that the machine built for this purpose is of the drum or continuous type in which the castings are set up by the operator in fixtures mounted on a drum that rotates without interruption. With this arrangement both the machine and operator are constantly employed. Pads on the fixtures locate the work by coming in contact with the six spots milled in the preceding operation. The fixtures are of a simple design, the casting merely being seated in place, two straps *A* tightened, and screw *G* turned to adjust a wedge against the back of the casting. This wedge takes the thrust of the milling cutters.

Rough and finish milling cuts are taken on both the top and bottom of the cylinder block. There are cutters at *B*, *C*, and *D* for taking rough cuts, and cutters at *E* and *F* for taking finishing cuts. One operator handles this machine, with the assistance of the operator who runs the machine used in the preceding operation. The conveyor system delivers castings at the rear of the machine, where the loading and unloading station is located. The estimated production on this operation is twenty-four castings per hour.

Holes are next drilled and reamed in the cylinder block to receive pins used for locating the work in subsequent machines. The castings are then set up in the machine illustrated in Fig. 2; in this case the work is located in the fixtures by the milled lower surface and by dowel-pins that enter the holes just produced. It will be seen that this machine, like the preceding one, is of the continuous drum type.

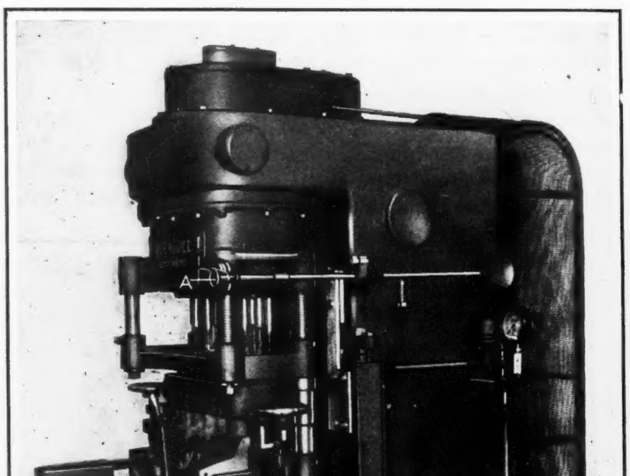

Fig. 6. Multiple-spindle Drilling Machine in which the Knee is fed to the Spindles through the Use of an Oilgear Pump

The work is clamped by a strap *A*, which is bolted on top of the casting after it has been set in the fixture. The machine is equipped with six cutter-spindles, three for rough-milling the end pads and the pump boss, and three for finish-milling these surfaces. The machine is attended by one operator, and the production is thirty-one cylinder blocks per hour. On both this machine and that shown in Fig. 1, rotation of the work-carrying drum is effected by a worm and worm-wheel, so as to obtain uniform rotation and eliminate serious vibration.

Milling the Valve Cover Seat and the Manifold Pads

In the next operation, a machine equipped with a two-spindle traveling head, as shown in Fig. 4, is used for milling the valve cover seat and the manifold pads on the cylinder block. The work is again located from the reamed dowel-pin holes and the milled bottom of the casting, and is quickly clamped in the fixture by turning handwheel *A*. The cutter-head is mounted on a slide to permit feeding the cutters over the work. The feed is engaged by tripping hand-lever *B*. The machine is operated at a feed of 32 inches per minute.

Roughing and finishing cuts are taken with the same set of cutters. The roughing cut is taken during the forward travel of the cutter-head, and the finishing cut during the return travel. Obviously, it is necessary to move the cutters toward the work at the

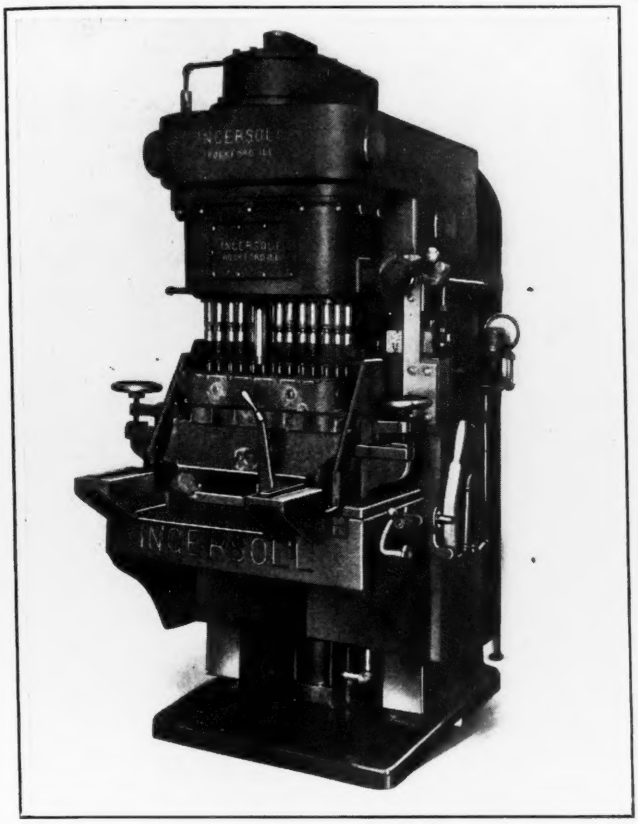

Fig. 7. Machine equipped with Twenty-four Spindles for performing Two Successive Operations on Twelve Holes

end of the roughing cut, an amount equal to the depth of the finishing cut. This is accomplished by having the cutter-spindles mounted in a quill that is adjustable by an arrangement of wedges to set the cutters properly for the two cuts.

At each end of the machine, there is a cylinder *C* in which there is a spring and from which a plunger projects. When the roughing cut has been completed, a stop on the cutter-head engages the plunger of the right-hand cylinder, and further movement of the head compresses the spring in this cylinder until the pressure is sufficient to throw the wedge and cause the spindle quill to advance the cutters toward the work for the finishing cut. At the same time the movement of the cutter-head is automatically reversed. When the finishing cut has been completed, a stop on the left-hand side of the cutter-head engages the plunger of the left-hand cylinder *C*, causing the spindle quill to move back and reset the cutters ready for the roughing operation on the next casting. Movement of the head on its slide is automatically stopped at the end of an operation to permit the machine to be reloaded, but after the feed has once been engaged, the machine passes through its complete cycle without further attention on the part of the operator.

Boring, Drilling, Reaming, and Countersinking Operations

One pumpshaft, six camshaft, and seven crankshaft bearings are next rough- and finish-bored in the crankcase portion of the cylinder casting, by employing two machines of horizontal design. Each machine is equipped with two fixtures mounted on an indexing table, and two sets of three boring-bars which are alternately connected to the spindles of the machine through suitable chucks. With this design, a casting may be loaded in one fixture while an operation is in progress on a casting in the other fixture. Of the three bars in each set, only the one used in boring the camshaft bearings need be withdrawn from the fixture for reloading, as only one-half of the crankshaft bearings are contained in the cylinder casting and the pumpshaft bearing is bored by means of an overhung cutter. The production on these operations averages twenty castings per hour.

Forty-six holes are next drilled simultaneously in the cylinder block by the use of a machine equipped with one multiple-spindle vertical head and two multiple-spindle horizontal heads. Sixteen of these holes are drilled in the front end of the cylinder block, twenty-two in the top, and eight in the rear end. An Oilgear pump is provided for feeding the heads to the work, and there is also an automatic electric control provided with a push-button starter. The estimated production on this operation was thirty-five castings per hour, but in actual operation, this estimate has been exceeded by a wide margin.

Fig. 5 illustrates a two-head machine built for drilling thirty-seven holes in the bottom of the cylinder block, and fourteen holes in the valve cover side. As in preceding operations, the work is located from the lower milled surface and from the reamed dowel-pin holes. Feeding of the heads is again accomplished by means of an Oilgear pump furnished with an automatic electric control and a push-button starter. It is necessary that the feeding movements of the vertical and horizontal heads be synchronous, in order to feed the drills to the work at the same rate. This is accomplished through rack *A*, pinions, and a rack attached to the horizontal head. The estimated rate of production was thirty-two castings per hour, but as in the preceding case, this output has been exceeded.

The machine shown in Fig. 6 is a one-way twenty-four-spindle drilling machine built for drilling twelve water circulating holes and twelve valve guide holes in the cylinder block. The work is located as in the previous operation. For feeding the drill head, use is again made of an Oilgear pump, which functions through a cylinder mounted at the back of the knee. The pump is hand-operated through control lever *A*. One operator handling this machine obtains a production of from thirty to thirty-five castings per hour.

Another single-head drilling machine equipped with twenty-four spindles is illustrated in Fig. 7. This machine is designed for performing two successive operations on twelve holes. At the first setting of the work, twelve of the spindles are brought into action for rough-reaming the valve guide holes and boring the throats of the valves, while at the second setting of the work, the remaining twelve spindles finish-ream the valve guide holes and finish the valve

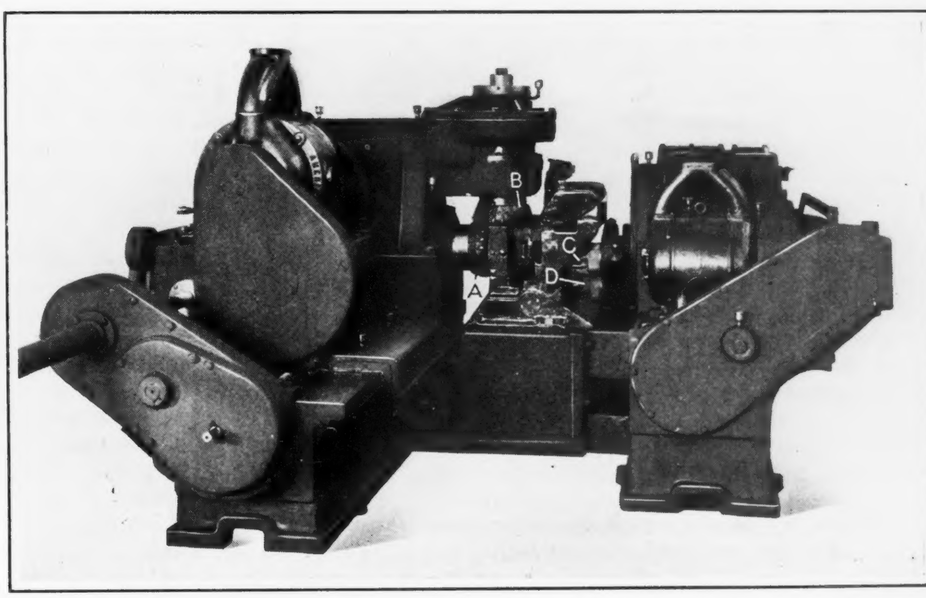

Fig. 8. Machine for milling the Rear End, Cover Pad, and Bell Housing End of a Transmission Case

seats. During the finishing operation, a stop comes into contact with the finished top of the cylinder block to control the depth of the valve seats. The holes are piloted both above and below the work to insure accurate alignment. At the first setting of the operation, the spindles in the rear row function, and those in the front row merely pass down through the cylinder bores.

The knee of this machine also is fed by an Oilgear pump, the up and down movements being controlled through the hand-lever shown at the right-hand side of the head. One operator attends this machine, and obtains a production of twenty-seven castings per hour. In all the multiple-spindle drilling machines mentioned, the drill spindles are located at fixed center distances.

Milling Transmission Cases

A milling machine equipped with a traveling head that carries a vertical and a horizontal spindle, and a rotary head carrying two horizontal spindles, is shown in Fig. 8. Cutters *A* and *B* of the traveling head mill the rear end and the cover pad of the transmission case, and cutters *C* and *D* on the spindles of the rotary head mill the bell housing end of the same piece of work. The transmission case is located for this operation from rough surfaces. The surfaces milled by cutters *A* and *B* are finished by simply sliding the head past the work; however, cutters *C* and *D* function in a different manner. The spindles that carry these cutters are eccentrically mounted in a quill which is rotated to swing the cutters over the surfaces that they mill. One operator handles this machine, and averages fifteen or sixteen pieces per hour.

All the machines described in this article are equipped with an individual motor drive and provided with flooded lubrication. The fixtures, boring-bars, and milling cutters were made by the builder of the machines.

* * *

ANNUAL MEETING OF WELDING ENGINEERS

The annual meeting of the American Welding Society was held in the Engineering Societies' Building, 29 W. 39th St., New York City, April 22 to 24. During the first day, meetings were held by the resistance welding committee and the gas welding committee. A report was presented on the work done on resistance welding of special metals, and also a progress report on the welding of manganese steel. The electric arc welding committee presented a progress report on an investigation to determine certain fundamentals of electric arc welding, such as the effect of various currents, angles of bevel, number of layers of deposited metal, and size of electrodes. A progress report was also submitted by the sub-committee on arc welding of non-ferrous metals. The educational committee of the society met to discuss plans for the work of this committee and ways and means for carrying out these plans.

At the morning session, Thursday, April 23, the president's report of the year's activities was presented, and reports were received from various standing committees. In the afternoon an inspection trip was arranged through the Bay Way Plant of the Standard Oil Co. of New Jersey. The inspection trip covered a visit to the shops where the making of various welded joints in pressure vessels were seen; in the field, welded joints on lines and headers, replacing the fittings formerly used, were inspected.

April 24, a symposium covering methods of inspecting welds and testing the skill of operators constituted the forenoon's program. About thirty experts in a wide variety of fields gave a summary of the practices employed in their respective industries on the subjects mentioned.

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In 1912, when there were 944,000 automobiles in use in the United States, the number of telephones was 8,730,000. In 1923, there were 15,370,000 telephones and almost exactly as many motor vehicles.

IMPRESSIONS FROM A VISIT TO EUROPE

By HENRY S. BEAL, Assistant General Manager
Jones & Lamson Machine Co., Springfield, Vt.

Having just returned from an extensive journey through a number of the countries in Central Europe, the writer wishes to note down a few of his impressions. My first and most definite impression was of the magnitude of the German machine tool industry and the lack of any important machine tool industry in France. In Germany, one finds large well equipped plants, built largely within the last ten years. One also finds in Germany highly advertised copies of American machine tools, and the interesting point is that to those on the spot this seems entirely rational.

In 1914, Germany was a large importer of American machine tools. When the war came, she had to have machine tools in great quantities and could not buy them from the outside. The tremendous demand on her manufacturers naturally made it necessary in many instances to copy American designs. These designs have been copied with varying degrees of success. Those who have great faith in German machine tools will tell you that certain of these machines are better in the German edition than they were in the American, owing to the improvements that have been made in Germany. Others tell you that these copies are not nearly so successful as the originals. In this connection, the comment of one German manufacturer is interesting. It was stated that a certain German machine tool builder was about to copy a well-known American production machine. The comment made was to the effect that while the news contained nothing of a surprise, the American builder of the machine should not be worried because the German machine tool builder who was planning to copy this machine had already copied two other American machines unsuccessfully.

On the other hand, it is undoubtedly true that there are at least two or three machine tool builders in Germany who have made real contributions to machine tool design in recent years. The general opinion in Germany among the higher grade of manufacturers in the metal-working field seems to be about this: The design of standard tools in Germany is in a very satisfactory condition, and Germany is ideally situated, owing to her labor market, to produce standard machines of a quality and at a price that can successfully compete with American and British manufacturers.

On the other hand, Germany has not a sufficient market for the highest type of production machinery to make it worth while to attempt to compete with American machines of that type. This appears to be a controlling factor in the policy of large machine tools manufacturers in Germany who have in the past also been agents for American machine tools. Most of these concerns are now manufacturing machines of the standard type, but are acquiring American agencies for high-production types of machines.

While not having accurate statistics, my impression from what I observed is that the German machine tool industry on the whole is operating at a higher percentage of capacity than the American. The English machine tool builders also appeared to be quite busy. Several of the plants in England were operating on two shifts. The business appeared to be quite largely export business. A large percentage has, I believe, come from France during the last year and a half.

It is undoubtedly true that American machines would have a market in France if the exchange situation could be brought more nearly back to normal. On the other hand, there is a very strong national feeling in France today against buying anything from the United States that can be bought either at home or elsewhere. I understand that to some extent French manufacturers are urged through their trade organizations not to purchase American goods and thereby increase the already enormous bill that France owes the United States.

In a general way, one cannot investigate the European market without being greatly impressed with the future possibilities for American machine tools, especially of the production type.

RECLAIMING MACHINE PARTS AND TOOLS

By S. W. BROWN

The reclaiming of machine parts and tools should be practiced by every manufacturer of these products. To scrap every piece of work that does not pass inspection is unnecessarily wasteful. This does not mean that machine parts or tools should be reclaimed by any method that depreciates the work, such as plugging holes that have been drilled in the wrong location or plugging bushing holes that have been bored too large, shrinking sleeves on parts that have been turned too small, riveting on patches, or welding on stock and machining it over. Any of the foregoing methods may be all right for an emergency job, but the quality of the work is impaired even if done so skillfully that it cannot be detected. There are methods of reclaiming, however, that leave the work in as good condition as the regular product.

Reclaiming by Expansion

Suppose we have a lot of bronze bushings that are to be used as bearings in machines. These bushings are usually pressed into the machine frame and reamed in position after the machine is assembled. Assume that the bushings do not pass inspection as the outside diameter is 0.001 inch or more under the limit.

Now it is an easy matter to save these parts by pressing a smooth well oiled mandrel into the hole until it expands the bushing to the required size. An arbor press and a lathe mandrel can be used for the expanding operation with very good results. As there is sufficient stock in the holes of these bushings for reaming, the slight amount that the holes are enlarged does not do any harm, especially if the bushings are to be pressed into machine frames, as that operation often closes in the holes nearly as much as they have been expanded by the mandrel.

A lot of rather costly parts such as shown in Fig. 1 were reclaimed by expansion. The thread on the piece was cut slightly too small, and to remedy this error a 3/16-inch hole was drilled in the center of the projection at *B*. A mandrel pressed into this hole served to expand the threaded part enough to permit recutting the thread to the correct size. The 3/16-inch hole did not weaken these parts to any great extent, and they were considered very satisfactory for the purpose required.

Reclaiming by Contraction

Holes that have been reamed too large in bronze or steel bushings may be closed in enough to permit reaming over again by pressing the parts through a hardened steel bushing having a thick wall. Of course, it is necessary to have enough stock on the outside diameter of the parts when this method is employed. In one case a lot of thread gages were contracted enough in this way to permit them to be retapped. If the walls of the bushings are very thick, it is difficult to contract the holes by this method, but for thin-walled bushings it is very satisfactory.

Reclaiming by Peening

Very often cast-iron levers or similar parts are milled inaccurately, as a result of faulty methods of holding or clamping the work for the milling operation. In Fig. 2 is shown a lever having the end bent down slightly so that dimension *A* is 0.020 inch under size. Peening the part at or near point *B*, however, will cause the end of the lever to move in the direction of arrow *C*, thereby correcting the error. Sometimes it is necessary to peen the lever over more than the amount of the error and then force it back again by peening it at point *D*. This method is used to make the slot parallel with the finished surface *E* of the hub.

With a little practice, levers or similar parts may be peened into the correct position quickly and satisfactorily. Peening sometimes leaves a few unsightly marks, but these may be smoothed over with a coarse file, and in many cases this kind of work receives a finish such as enamel or paint which will cover up any slight dents in the metal.

Reclaiming by Heating and Quenching

The holes in jig bushings and similar parts are often bored or reamed out too large, or are so distorted in hardening that there is not enough metal left to permit them to be ground or lapped to the correct size. In many cases these bushings may be reclaimed by heating them to a cherry red and quenching by rolling them upon a wet board. It is a good plan to set the board in a tank of water so that the upper side of the board will be slightly below the surface of the water. A small rod passed through the hole in the bushing provides a convenient means of holding the part during the rolling process. After this operation, the bushings may be rehardened.

External gages like the one shown in Fig. 3 are often ground or lapped slightly too large. These may be reclaimed by slightly heating the portions of the gage at points included within the dotted lines at *A* and *B*, and quenching. This will close the slot enough to permit regrinding or relapping to the correct size. Of course, care

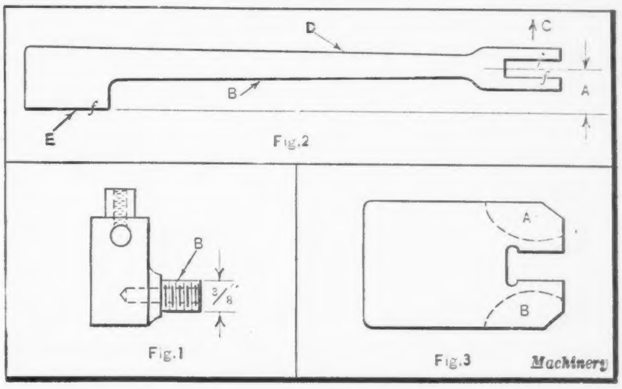


Fig. 1. Part reclaimed by expanding and retapping. Fig. 2. Example of Work that can be straightened by peening. Fig. 3. Gage reclaimed by heating

should be taken in heating not to draw the temper of the gage. It is not necessary to draw the temper of any part of the gage to close in the slot the small amount necessary.

Cost of Reclaiming

Before attempting to reclaim any parts, it is a good plan to estimate the probable cost. If it will cost as much or more to save a lot of parts as it will to make new ones, the best plan, of course, is to scrap them. Fortunately, if reclaiming can be done at all, it usually can be done at a very low cost, often not exceeding 5 per cent of the cost of making new parts. Thus the reclaiming of machine parts and tools may be considered good practice and wise economy.

Using Scrap for Stock

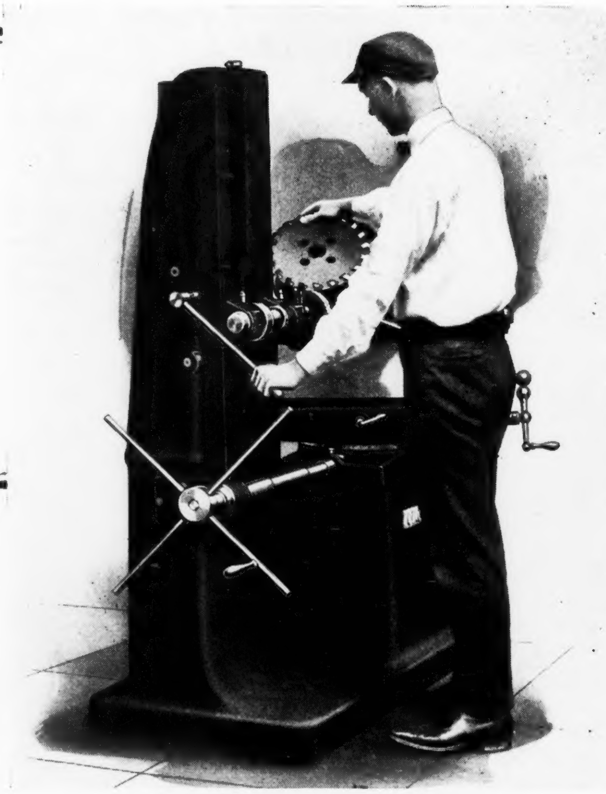
Parts that must be scrapped should be looked over, and scrap parts such as bushings, shafts, steel blocks, and similar parts turned into the stock-room to be used for odd jobs. Tool and machine steel parts should be separated.

* * *

The United States has supplied about one-third of the machinery imported by Great Britain since 1921, according to figures recently published in *Commerce Reports*. The fact is especially interesting because German manufacturers during this period, as well as the machine builders of other European countries, have enjoyed the advantage of a declining exchange. Nevertheless, British purchases have shown constant increases during the last three years. The weight of machinery imported into the United States in 1924 was approximately half that of 1913, although the value in dollars and cents was greater than the value previous to the war. At the same time Great Britain exported in 1924 a tonnage equal to about two-thirds of that in 1913, the value per ton being about twice the prewar value.

Grinding Face Milling Cutters

How the Periphery, Corners, and Face of Milling Cutters of the Inserted-blade Type are Sharpened



HIGH efficiency in milling operations demands the use of properly ground cutters. If cutters are correctly ground as regards clearance and concentricity, greater service between grinds will be obtained, faster rates of feed can be used, and the work will have a better finish. The blades of inserted-tooth face milling cutters must be ground on the periphery, corner, and face. On some large cutters intended for taking roughing cuts, it is desirable to grind the corner of the blades to three different angles, as illustrated in Fig. 2. These three corner surfaces, the periphery, and the face can be ground at one setting of the cutter and one setting of a tooth-rest, in a machine recently developed by the Cincinnati Milling Machine Co., Cincinnati, Ohio. The method of grinding a milling cutter on this machine will be described in the following.

From the heading illustration and Fig. 1 it will be seen that on the main bed of the machine there is an upright member which supports a grinding wheel slide *A* that may be raised and lowered on the column. The bed also supports a slide or saddle *B* that carries a swivel housing *C*, which, in turn, supports a carrier *D* and a cradle *E*. The milling cutter to be ground is supported by a spindle contained in a swivel member mounted in the cradle. Saddle *B* can be adjusted longitudinally on the bed, housing *C* swiveled on the saddle, carrier *D* shifted crosswise on its slide, and cradle *E* tilted to bring the milling cutter into any position for grinding either the periphery, face, or corners. The tilting of the cradle is accomplished through a worm and worm-wheel mechanism actuated by means of a crank.

Setting the Cutter

Before putting a milling cutter in place for sharpening, the cutter-spindle is placed in the vertical position, the various dials set at zero and the swivel housing located perpendicular to the grinding wheel spindle. The milling cutter is then mounted on the spindle and clamped in position, as shown in Fig. 1. It is necessary that the particular blade to be ground be vertical, and to accomplish this result the milling cutter spindle is tilted to the angle at which the blade is set in the body. This is usually 7 degrees on standard milling cutters. The handwheel *X*, Fig. 4, of the worm mechanism is turned in making this adjustment. Any tooth may now be squared with the grinding wheel, as shown in Fig. 5, which is a plan view. To prevent the cutter from rotating temporarily, the spindle is locked by means of a thumb-screw. The tooth-rest is finally set in position against the front face of the blade just squared up.

Grinding the Periphery and the Corners

Most face milling cutters have the blades set in the body in such a way that an effective rake or under-cut of from 10 to 15 degrees is produced on the peripheral edges. In grinding the periphery of a milling cutter on this machine, the desired clearance is obtained by rotating the swivel housing an amount equal to the number of degrees of under-cut plus the number of degrees of clearance. For example, if the blades of a cutter are set to give an under-cut or rake of 15 degrees, the housing must be swiveled 25 degrees in order to obtain a clearance of 10 degrees.

Grinding the clearance is accomplished by moving the wheel up and down over the blade. To obtain the back or secondary clearance, the housing is swiveled 3 more degrees and the blade ground in such a way as to leave a land about 1/16 inch wide on the cutting edge. Fig. 1 shows the machine set up for grinding the periphery of a cutter.

For grinding the corners of the blades, the saddle is moved away from the grinding wheel far enough to permit swinging the cradle and the milling cutter down 22 1/2 degrees, as shown in Fig. 3. This setting is accurately made by means of the dial adjacent to the crank used in tilting the cradle. A vernier is provided with the dial for accurate angular setting of the cradle. The cradle is then locked in this position by clamping

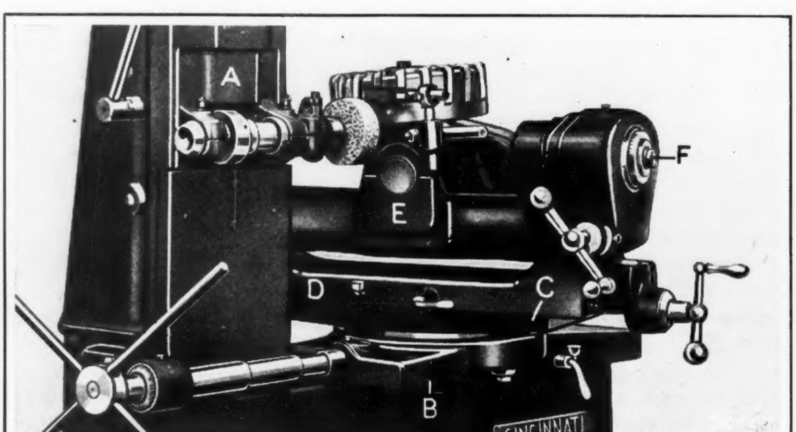


Fig. 1. Set-up of Machine for grinding the Periphery of a Face Milling Cutter of the Inserted-blade Type

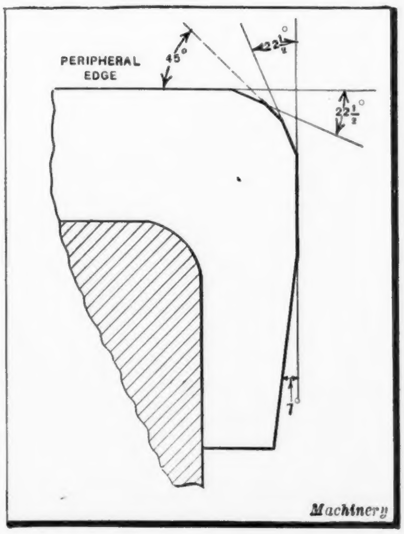


Fig. 2. Outline to which Inserted Blades of Face Milling Cutters are sometimes ground

the bolt shown at *F* in the illustration Fig. 1. Next, with the angular position of the swivel housing the same as when grinding the periphery of the cutter, the first corner angle of the cutter, as shown in Fig. 2, is ground. For grinding to the 45-degree angle, the cradle and milling cutter are tilted an additional 22 1/2 degrees. Finally, the corner is ground to the 67 1/2-degree angle after making another setting by following exactly the same procedure as in the two previous steps.

Grinding the Face

In setting the machine for grinding the face of the cutters, the saddle is moved still farther out on the bed to permit swinging the cutter into the position shown in Fig. 4. Inasmuch as most inserted blades of face milling cutters are set in the body at an angle in order to give effective face rake, it is necessary to adjust the swivel housing an amount equal to the sum of the face rake angle plus the clearance angle desired. For example, if a milling cutter has an ef-

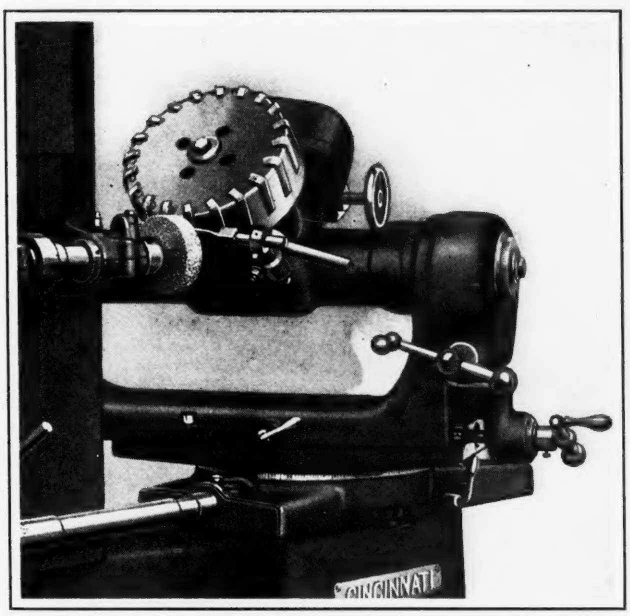


Fig. 3. Manner in which the Milling Cutter is tilted for grinding Angular Surfaces on the Corner of the Blades

fective face rake of 7 degrees, the swivel housing must be adjusted 17 degrees, in order to obtain a face clearance of 10 degrees. The last operation consists of grinding the back clearance, leaving a land about 1/16 inch wide behind the cutting edge. This step is performed after rotating the swivel housing 3 degrees beyond the first clearance angle setting.

The face of the blades can be backed off toward the center by dropping the axis of the milling cutter below horizontal and repeating the operation just described. In all the settings mentioned, it is desirable that the relative position of the wheel and the blade being ground, be such that the wheel marks are perpendicular to the cutting edge. This can be accomplished by means of a longitudinal adjustment of the cradle carrier.

One of the features of this machine is the use of a cup-wheel to obtain a strong cutting edge. The tooth-rest is of clapper-box construction. After the initial setting of the tooth-rest, a cutter can be completely sharpened without further setting. Milling cutters, either right- or left-hand, up to 18 inches in diameter can be accommodated on one size of machine, and up to 24 inches in diameter, on a larger size.

* * *

A slight improvement in the exports of metal-working machinery from the United States to France took place in 1924. The total value of metal-working machinery export-

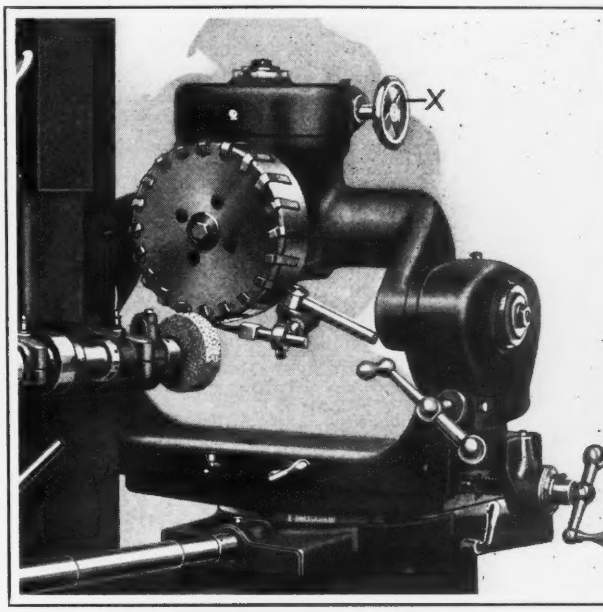


Fig. 4. Relative Positions of the Milling Cutter and Grinding Wheel in grinding the Face of Milling Cutter Blades

ed from this country into France in 1922 was valued at $1,022,000; in 1923, at $1,092,000; while in the first nine months of 1924, the figures rose to nearly $1,300,000. The exports of lathes in the first nine months of 1924 were double the exports during the entire year of 1923. There was also a considerable increase in the exports in the planer, shaper, and slotter group, power presses, milling machines, and screw machines. The grinding machine exports in the first nine months of 1924 were two and one-half times as great as during the entire year of 1923, and over three times as great as in 1922.

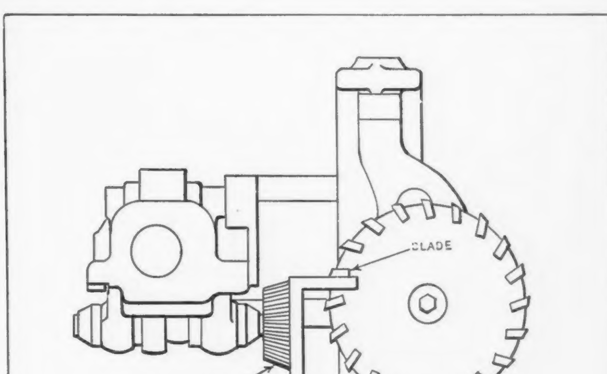


Fig. 5. Method of squaring a Blade of a Milling Cutter with the Grinding Wheel

THE ELIMINATION OF WASTE

In a pamphlet published by the United States Department of Commerce on "The Elimination of Waste," Herbert Hoover makes the following very clear and definite statement in regard to the importance of eliminating avoidable waste in industrial pursuits:

"The primary duty of organized society is to enlarge the lives and increase the standards of living of all the people. The whole basis of an increased standard of living, of better human relations, of national progress—indeed, of the advancement of civilization—is the continuous improvement in production and distribution.

"While we currently assume that great advancements in living standards are brought about by new and basic invention, an even larger field for advancement of those standards is found in the steady elimination of our economic wastes. We have probably the highest ingenuity and efficiency, in the operation of our industries, of any nation. Yet our industrial machine is far from perfect. The wastes due to unemployment during depressions; to speculation and overproduction during booms; to labor turnover and labor conflicts; to intermittent failure of transportation of supplies, of fuel, and of power; to excessive seasonal operation; to lack of simplification and standardization in many of our commonly used commodities; to loss in our processes and materials —all of these combine to represent a huge deduction from the goods and services we might all enjoy if we could but eliminate these wastes.

How a High Wage Level is Maintained

"The necessity of maintaining a high wage level requires that all processes of manufacture and distribution be reduced to the lowest possible cost. This can be done through the elimination of those wastes arising out of too high a degree of diversification in certain basic products. To-day dozens of different sizes, styles, types, and patterns of the most commonplace articles are placed in the market by manufacturers who must possess special equipment and skill to produce these endless variations. Merchants accumulate great stocks, which turn but slowly because of the excessive diversity and lack of interchangeability in their components. Because of this situation many manufacturers and distributors favor cooperation for simplification and standardization.

"The saving in national effort through such cooperation, as demonstrated by many well-known examples of simplification and standardization, runs into millions of dollars. There is a great area still untouched, in which the application of these waste-eliminating measures may well save not millions but billions. The consequent reduction of manufacturing, selling, and distributing costs, and the release, for active use, of millions now tied up in slow-moving stocks combine to yield savings eventually reaching the consumer in lower prices, thus increasing his real wages and assisting him to a higher standard of living. The rate of our advance must be, and will be, in proportion to the extent in which we all cooperate for the elimination of waste."

The booklet in which Mr. Hoover makes these statements relates to "Elimination of Waste: Simplified Practice—What It Is and What It Offers." The pamphlet gives an outline of what has already been accomplished by cooperation between the Department of Commerce and various industrial groups in eliminating unnecessary sizes and types. It may be obtained for the price of ten cents from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Examples of Saving by Eliminating Unnecessary Sizes

As an interesting example of what can be done by industrial concerns getting together and deciding upon the elimination of unnecessary sizes, it may be mentioned that the gages and sizes of sheet steel have been reduced from 1819 to 263; and that 7000 catalogue items in builder's hardware have been reduced 26 per cent, and the varieties in finishes used, 71 per cent. The standardization of the varieties of sheet steel, it is stated, foreshadows a saving of more than $2,500,000 a year in this industry, according to an estimate furnished to the Division of Simplified Practice, Department of Commerce, by Walter C. Carroll, vice-president of the Inland Steel Co., Chicago, who was a leading figure in the movement to reduce the variety of sheet steel sizes.

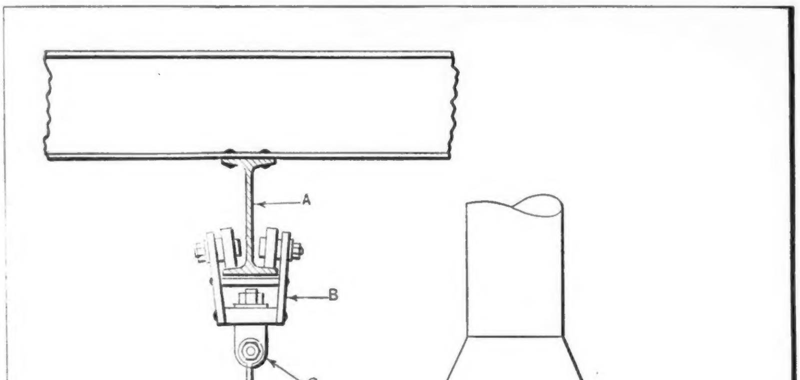


Fig. 1. Lead or Cyanide Furnace with Equipment for handling Multiple Holders

Thirty-five manufacturing corporations, operating 686 mills are affected by the simplification, the total production affected being about 5,000,000 net tons. In investigating the subject, it was found that 85 per cent of the demand in the trade was for 15 per cent of the sizes manufactured before the simplification work was undertaken. It would doubtless be found in other industries that much the same condition exists and that numerous sizes and types of finished articles, machines, devices, or grades of materials could be eliminated without any inconvenience to the industries making use of the manufactured goods, and with great savings to both manufacturers and users.

HANDLING WORK IN HARDENING BATHS

EQUIPMENT FOR HARDENING WORK IN CYANIDE AND LEAD BATHS

By C. T. KETZ

The placing of bundled work in cyanide or lead hardening baths is tiresome work, especially if the bundles are comparatively heavy and are handled with the ordinary long-handled hooks. The use of hooks or holders with long handles is necessary, however, in order to prevent the workman from coming too close to the heat and poisonous lead or cyanide vapors emitted from the furnace. The same conditions also exist when multiple holders are used. In order to make the work of the hardener easier, the equipment shown in Figs. 1 and 2, was installed in one plant.

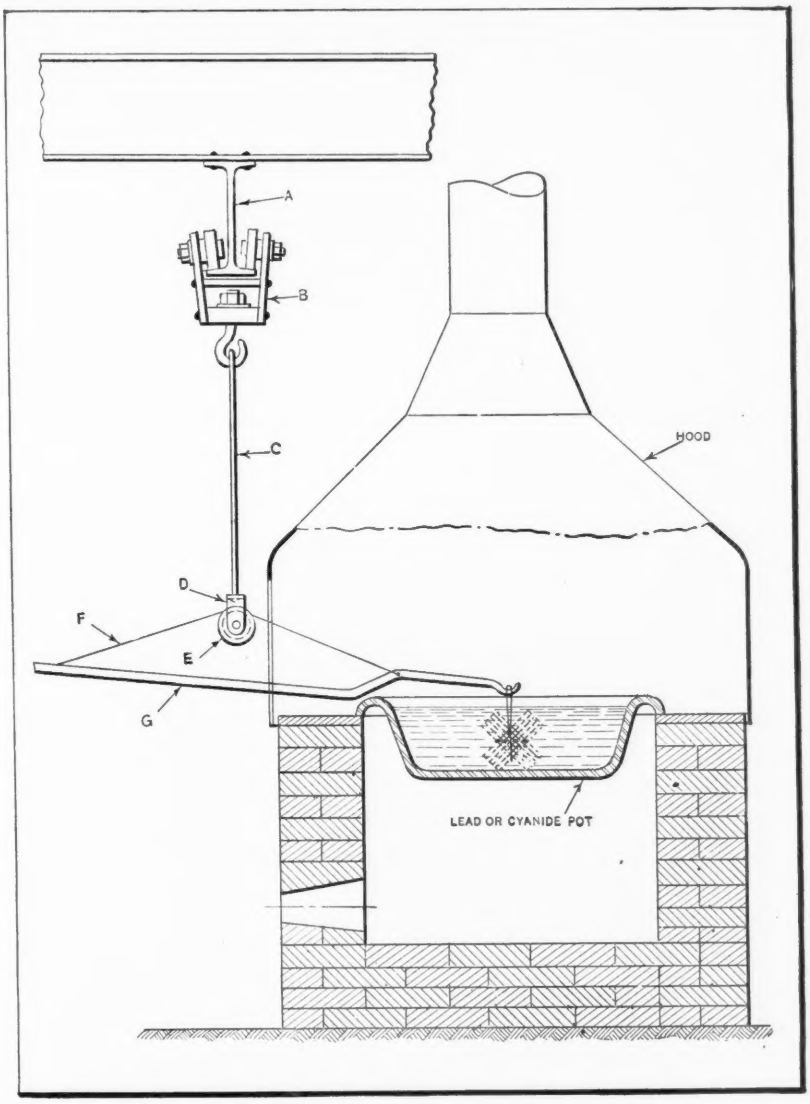


Fig. 2. Hardening Furnace equipped for handling Bundled Work

Equipment for Handling Multiple Holders

Referring to Fig. 1, *A* is a light trolley rail fastened to the building structure in front of the furnace. To the small trolley *B*, which rides on rail *A*, is fastened a long hook *C*. Hook *C* hangs on a pivot *G* which can be turned around and also swung in any direction. The work-holders are loaded on a bench next to the furnace and are picked up by the hook *C* and placed first in the preheater or on top of the furnace next to the hardening bath, as the case may be. When the work has reached the proper preheating temperature, it is submerged in the hardening bath. After remaining submerged for the specified length of time, the holder is engaged by hook *C*, lifted from the heating bath, and allowed to remain over the bath for a moment so that the excessive lead or cyanide will drip off into the hardening pot. The holder is then swung out to clear the furnace hood, and the trolley conveys the work to the quenching tank, where it is cooled. The operator can perform these operations from practically one position, and thus loses no time in walking to and from the loading bench, furnace, and quenching tank. As most of the weight of the loaded holders is carried by the trolley, the workman's energy is conserved and much better results obtained.

Method of Handling Bundles

Bundled work is handled in much the same way as work loaded in holders, the arrangement being shown in Fig. 2. Here we have the rail *A* and trolley *B*, with the hanger *C* fastened to the trolley. The lower end of hanger *C* is provided with a revolving yoke *D* which holds the sheave *E*. A light wire rope *F* running over this sheave supports the bar *G* which has a hook formed at one end for picking up the wire around the bundle. The bundles are hooked on a bundling bench close to the furnace, and are placed in the preheater or on top of the furnace next to the hardening pot for preheating. The other operations in handling the bundles are the same as in the case of work held in multiple holders.

The equipment shown in Figs. 1 and 2 is not costly and can be built in the home plant, where it will be found to pay for itself in a very short time. It not only increases the efficiency of the operator, but also enables larger bundles and holders of greater capacity to be handled. One equipment can often be made to serve several furnaces arranged in a row, so that the investment is very small.

Various Types of Multiple Holders

The holder shown at *A*, Fig. 3, is used in cases where all surfaces of the lower ends or heads of the pieces must be acted upon uniformly by the hardening bath. In this case, the work is spaced by round pins or flat spacing blocks in the stationary member of the holder, while the moveable jaw serves as a clamp.

The holder shown at *B* is of simple design and is employed for articles having an opening at the center through which it can be inserted. A holder of this kind is very convenient for handling small mallet heads or similar products that are to be heated in lead baths. It is needless to mention that the hole through the work must be oblong and that the bar must fit this hole in order to prevent the pieces from turning on the bar as no clamp is provided. With this arrangement there is no difficulty in keeping the work in an upright position. The stop-pin *N* prevents the pieces from coming in contact with the lead pot. The bar is bent up at the end so that the articles cannot slip off while being transferred from one place to another.

When the pieces are light in weight, the holders may be made double, but if this is done care must be taken not to make them too long. The holder shown at *D*, Fig. 4, is used for long light work which is to be hardened at one end only, and it is of such a design that the head end of the work is used to obtain the required spacing. If the work is quite long, the holder may be laid on firebricks of suitable height, placed on each side of the pot. A modification of the type of holder shown at *A*, Fig. 3, is illustrated at *C*, Fig. 4. Here the sides of the pieces are parallel, but as all sides of the pieces are required to be heated, means are provided for obtaining the required spacing. This is accomplished by having evenly spaced notches on the inner side of the clamping piece.

Angular pieces that are required to be heat-treated on only one end may be conveniently held in the manner indi-

cated at *E*, Fig. 5. The holder illustrated consists of two bars *O* and *P* and a clamp *Q*. If required, spacing pins may be driven through holes drilled in bars *O* and *P*. Where both ends of an angular piece must be hardened, a three-bar type of holder like the one shown at *F* can be used to advantage. The work is held in contact with the bars *R* and *S* by the rod *T*, which acts as a clamp. If spacing of the work is necessary, pins or blocks can be fastened to either rod *R* or *S* or a combination clamping and spacing bar *Z* may be used. For very heavy pieces, it may be necessary to employ special supports like the one shown at *U*.

At *G* is shown a multiple holder for U-shaped articles. In this type of holder, the resting bars *V* have notches that act as spacers for the work, which is held in place by the clamp *X*. What may be termed a "duplex" holder is shown at *H*. This holder can be used for Z-shaped products. In this case, however, two hardening operations are necessary. Spacing notches may be provided on either bar *Z* or bar *Y*, and either of these bars can be used as the clamping member. After one end of the work is heated and quenched, the other end is preheated, placed in the furnace, heated and quenched in the same manner.

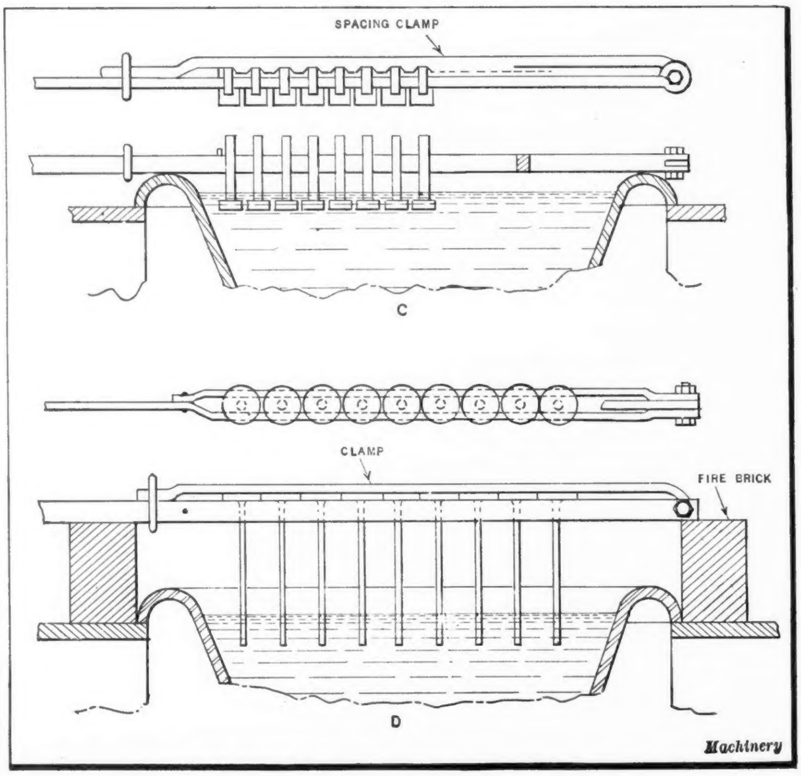


Fig. 4. Multiple Work-holders of Simple Design

Many other applications of multiple holders might be included, but those shown will give the reader an idea of the usual practice, so that the principles involved can be applied in constructing holders for articles of different sizes and shapes. By combining holders of suitable design with the handling equipment shown in Figs. 1 and 2, the efficiency of the operator and of the furnace can be increased considerably.

It may be well, in passing, to call attention to the design of the cyanide pot shown in Figs. 1 and 2. As will be noted from the illustrations, the rim of the pot, upon which it rests, is curved over at the top so that all the bottom surface will be uniformly heated. This prevents uneven heating, which often causes the rim of a hardening pot to crack.

* * *

MILLING CUTTER STANDARDIZATION

At a recent meeting held in the Department of Commerce, at which were present makers of milling cutters, milling cutter users, government officials and representatives of engineering societies, it was decided to eliminate about 35 per cent of the varieties and sizes of milling cutters now listed by manufacturers. The production of all but the standardized types will be discontinued on July 1 this year, and after January 1, 1926, all sizes not included in the standard lists will be considered special. Among those present at the meeting were Herbert S. Blake, secretary of the Milling Cutter Simplified Practice Committee, of New York City; Charles M. Pond, of the Pratt & Whitney Co., Hartford, Conn.; and C. W. Machon, of the Brown & Sharpe Mfg. Co., Providence, R. I., who represented the milling cutter manufacturers. Francis S. Walters of the Westinghouse Electric & Mfg. Co., of East Pittsburg, Pa., and E. K. Wennerlund of the General Motors Corporation, Detroit, Mich., discussed the simplification from the viewpoint of the user. These two men were named as representatives of users on the joint committee of the industry to continue work in this direction.

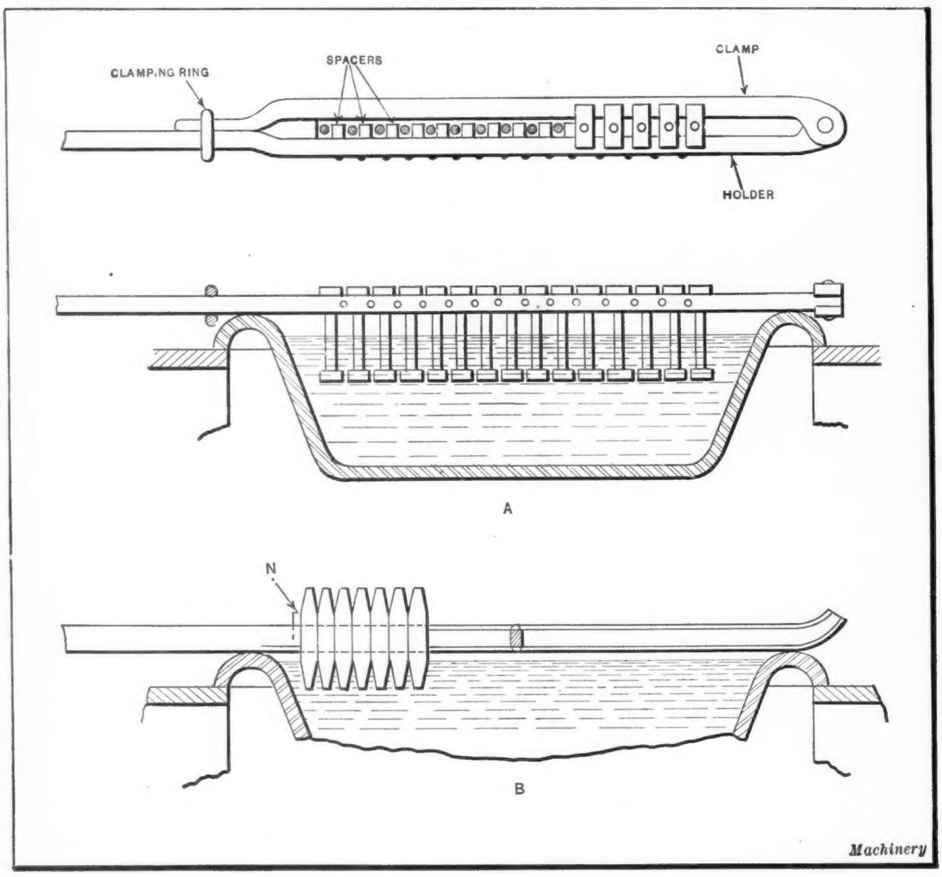


Fig. 3. Multiple Holders used when heating Work in Lead or Cyanide Bath

WORK SPEEDS FOR CYLINDRICAL GRINDING

The factors affecting the selection of the proper work and wheel speeds for cylindrical grinding are many and variable. In its present state of development cylindrical grinding may be rightly considered as an art in which the experience of the workman is one of the most important factors. The accompanying charts and the following information pertaining to the proper selection of work and wheel speeds by C. A. Carlson appeared in a recent number of *Grits and Grinds*, published by the Norton Co., Worcester, Mass.

The external cylindrical grinding of one particular piece of work can be done by several different methods; for example, it may be done with a wide-faced wheel using a fast table traverse and a comparatively slow work speed; or it may be accomplished by using a thinner wheel and taking a deeper cut with a slower table traverse and a faster work speed. If the work is not too wide or too long, a wide-faced wheel may be used to grind the whole surface with a straight in-cut. The last-mentioned method is probably the most efficient, assuming that the mechanical equipment is adapted to this method.

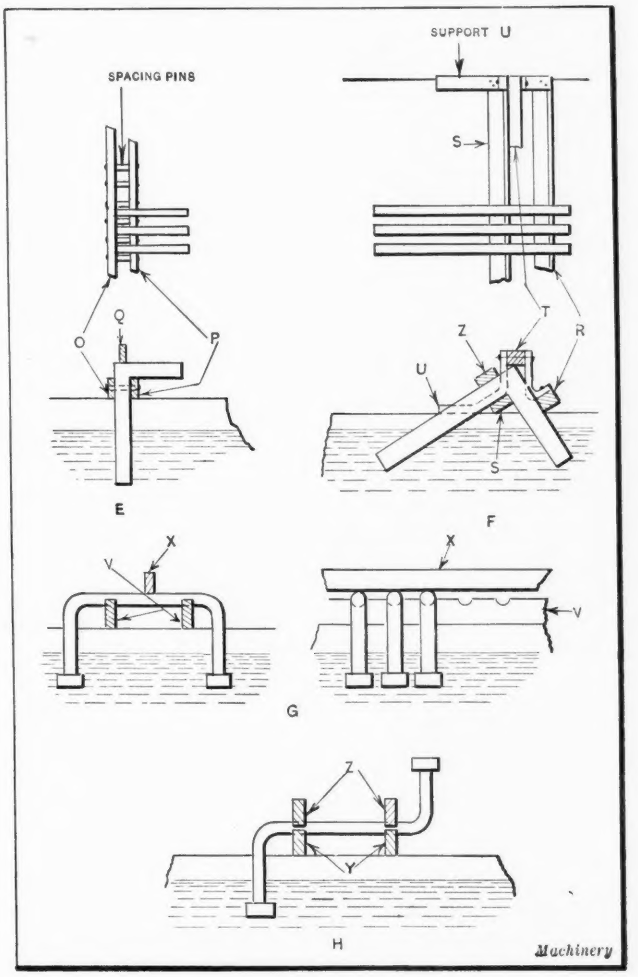


Fig. 5. Holders for Angular-shaped Work

Generally the first factor to be considered in determining upon the work speed is the size of the work and the kind of material to be ground—that is, whether it is hard or soft. Next the rate of feed and the finish to be produced must be considered. The condition of the machine is also an important factor; if the work is allowed to vibrate, good results cannot be obtained. It is assumed that an unlimited supply of power is available and that the wheel speed is constant.

A wide range of work speeds is available on most modern cylindrical grinding machines. The speeds can be changed not only to accomodate the different work sizes, but also to regulate the action of the grinding wheel in such a manner as to produce the required finish. Generally slower work speeds must be used for larger work. Slower speeds must also be used in many cases to prevent the wheels from breaking down on the grinding face, especially when heavier feeds are employed. Faster work speeds are used for smaller diameter work or when the wheels appear hard. If a high wheel speed is used, it is possible and usually advisable to increase the speed of the work.

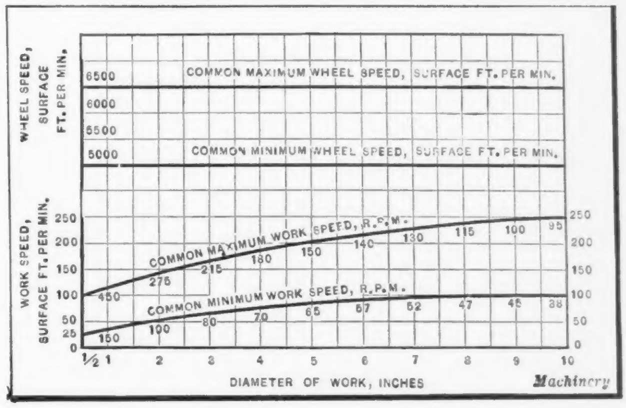


Fig. 1. Diagram showing Speeds generally used for External Cylindrical Grinding

There are some facts regarding work speeds that may be brought out more clearly by the use of diagrams For example, the work speeds, in surface feet per minute, are not the same for work of different sizes, but are higher for the larger sizes. This is necessary because of the longer arc of contact which prevents the cutting points from penetrating to the same depth as on work of smaller diameter. The diagram Fig. 1 shows the difference in speeds as the diameter increases and also the range of speeds commonly used for external cylindrical grinding. The proper selection within this range depends, of course, on the factors previously mentioned.

The factors governing the proper speeds and feeds for internal grinding are made more complicated by the necessity for using wheels of smaller diameter. This, of course, requires the use of slower speeds in surface feet per minute. The diagram Fig. 2 gives a good idea of the difference in both wheel speeds and work speeds that occurs in internal grinding at different diameters. Theoretically, the speed of the wheel, in surface feet per minute, should be the same regardless of its size, but there are many factors that tend to favor lower speeds for wheels of smaller diameter. One factor, for example, is the difficulty experienced in running wheel-spindles at very high speeds. The vibration encountered at the higher speeds also has a tendency to injure the wheel.

To sum up, it can be said that it is impractical to make any hard and fast rules or to try to find mathematically the proper work speed under all conditions. But with some little experimenting one can, without difficulty, find the practical limits of speeds for a certain operation.

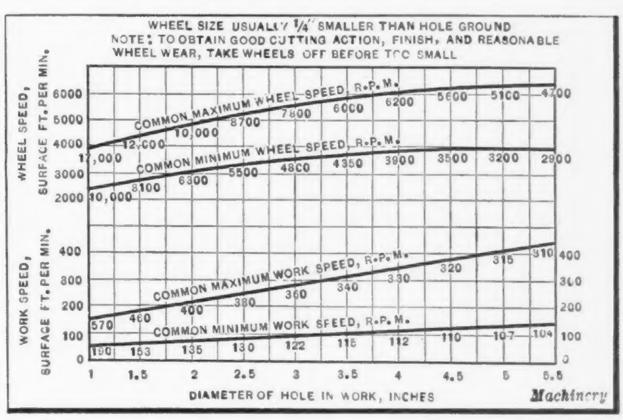
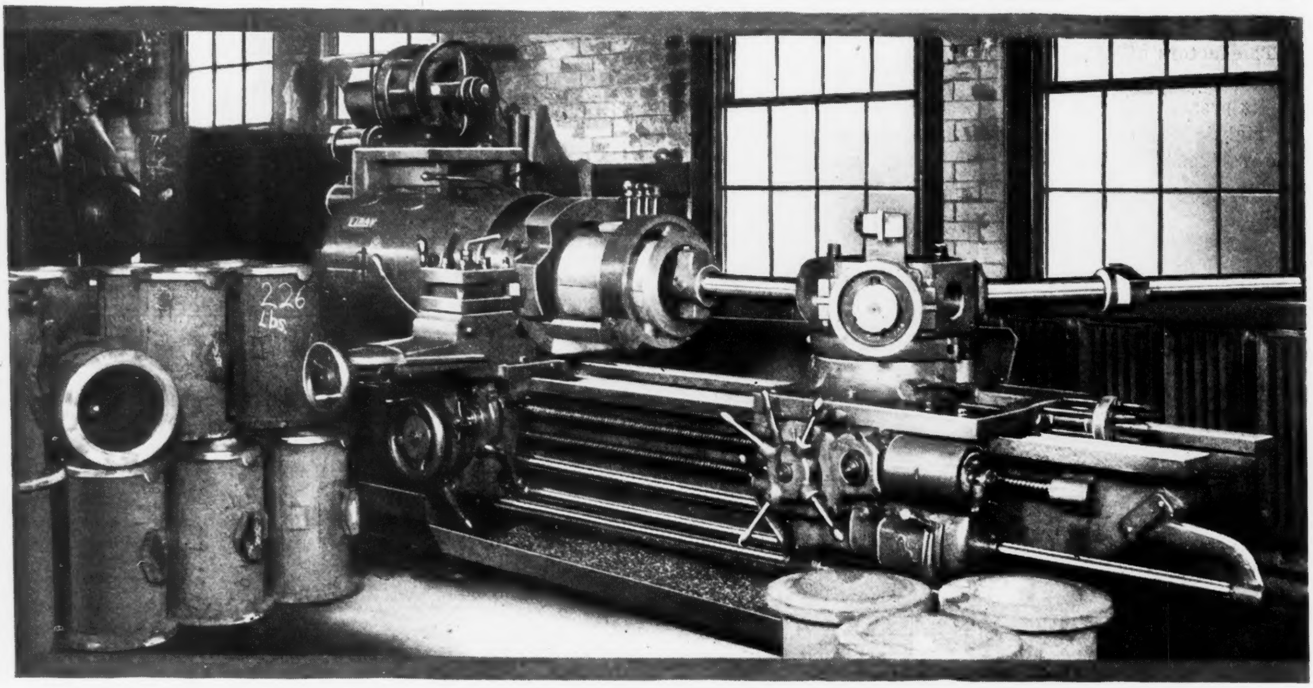


Fig. 2. Diagram showing Speeds generally used for Internal Cylindrical Grinding



Heavy Turret Lathe Work

Finishing Locomotive Power-reverse Cylinders and Large Worm Quill Forgings on Turret Lathes

By CHARLES O. HERB

THE general impression seems to be that the most common field for the turret lathe is the production of comparatively light work. However, certain types of turret lathes are used for handling heavy classes of work with a considerable saving in time. A job of this kind is shown in the heading illustration. Here a turret lathe is in use finishing locomotive power-reverse cylinders. With the equipment formerly used for this work, six hours was required to machine one of these cylinders, whereas they are now finished complete at an average of fifty minutes a piece. As will be seen from Fig. 1, the cylinder is bored 10 inches in diameter for a length of 20 inches, and this bore must be true within plus or minus 0.003 inch. In addition, other finishing cuts are taken, as shown by the heavy lines. Only two set-ups are necessary for this job. The machine on which the work is done is a Libby turret lathe, built by the International Machine Tool Co., Indianapolis, Ind.

The cylinder is a hard iron casting, about 1/2 inch thick around the bore when completed, and it weighs approximately 225 pounds as it comes to the machine. From 1/8 to 3/8 inch of stock is removed from each finished surface. Obviously, for a part of these dimensions and weight, it is necessary to supply well built and accurate chucks. At *B* in Fig. 3 is shown a pot chuck in which the work is held in the first set-up, and at *A*, a faceplate chuck on which it is centered for the second set-up. A machine cylinder is shown at *C*.

The pot chuck *B* is bolted to the front of a standard machine chuck, the jaws of which extend through slots *D* and grip the flange on one end of the work. The pot chuck is centered on the standard chuck by means of the hub at the bottom. The neck at the opposite end of the work is centered in the pot chuck by two screws *E* in the chuck body, and another screw *F* in the hinged clamp. By means of an indicator pin *G* in the chuck body and two similar pins on the hinged clamp, it can be determined when this end of the cylinder has been positioned approximately central with the machine spindle. As screws *E* and *F* are adjusted, the pins, being spring-actuated, extend more or less from the chuck. By applying a tool to these pins while the work is

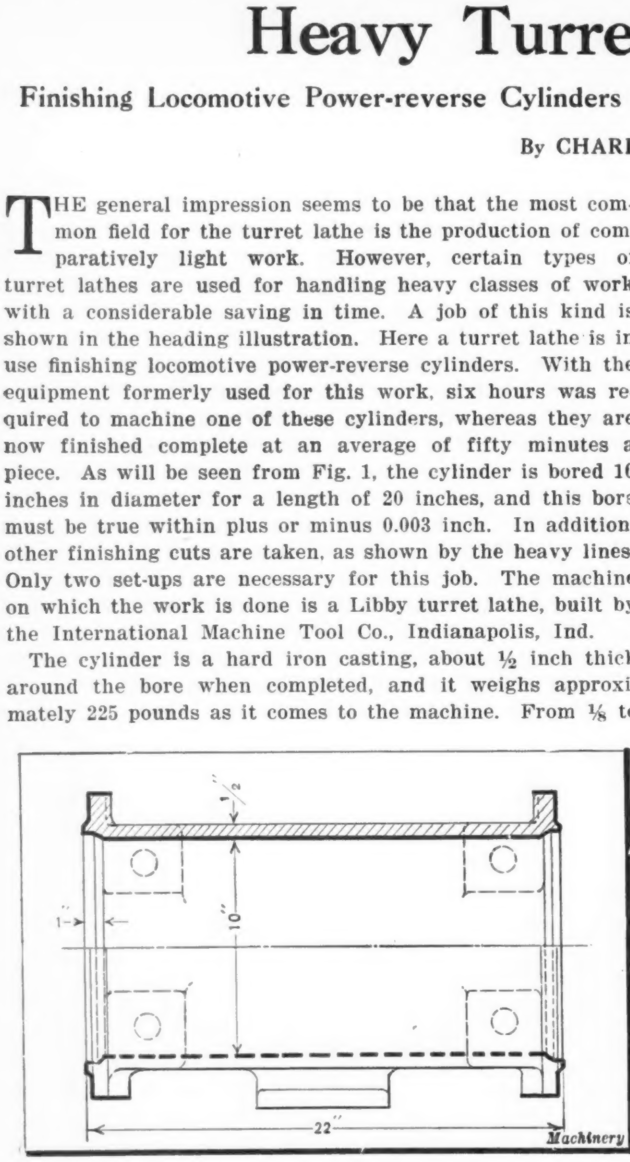


Fig. 1. Locomotive Power-reverse Cylinder weighing about 225 Pounds, which is machined Complete on a Turret Lathe

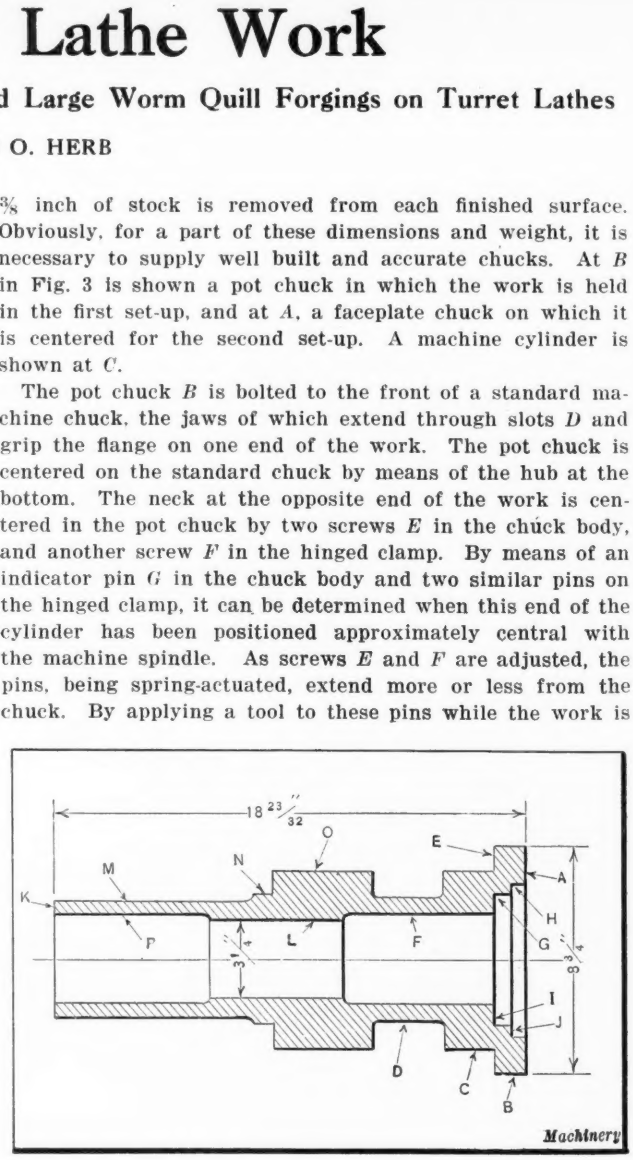


Fig. 2. Heavy Worm Quill Forging which is turned and faced all over and drilled, bored, and counterbored

revolved, it can readily be determined when the work has been made central. The boring-bars used in machining the cylinder have long pilots, which enter a self-lubricating bushing in the left-hand end of the chuck.

The tool equipment used in the first series of operations consists of two boring-bars, one tool-head, and four tools on the side carriage. The first step consists of rough-boring the cylinder for the entire length with a bar equipped with ¾-inch square stellite bits. Simultaneously with the rough-boring, the flange on the projecting end is rough-turned and rough-faced by means of tools on the side carriage. Then the cylinder is finish-bored with a bar similar to that used in the rough-boring step, with the exception that it is equipped with high-speed steel bits. The heading illustration shows this step about to be started.

Next, the tool-head on the turret is advanced to take the final cuts on this end of the cylinder. It will be seen that the head is equipped with a short arbor on which is mounted a pilot bushing which registers with the finished bore of the cylinder when the head is advanced, so as to support the tools rigidly. As the head is fed forward, the cylinder end is counterbored and chamfered by the horizontal tool seen on the right-hand side of the head. The flange post is finish-faced by means of the opposite horizontal tool, and the flange is finish-turned by the overhead tool.

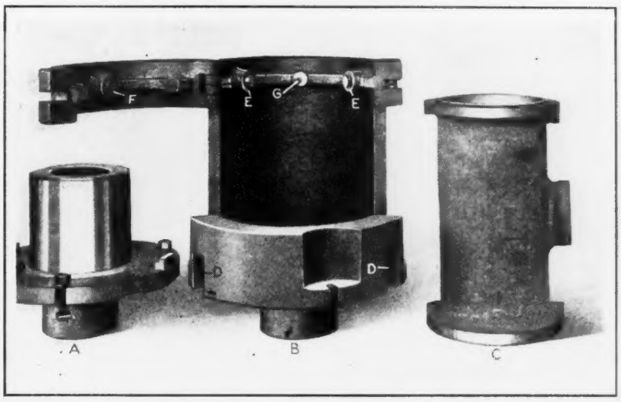


Fig. 3. Two Chucks used for holding the Power Reverse Cylinder on the Turret Lathe

Second Operation on the Cylinder

For the second operation the chuck shown at *A*, Fig. 3, is attached to the standard machine chuck, and the cylinder is seated on the large hub of chuck *A*, which fits the finished cylinder bore snugly. The cylinder is set up with the previously finished flange placed toward the headstock, and gripped by a set of soft jaws in the standard chuck. One of these jaws has a strap which engages the lug on the cylinder to drive it. The flange of the cylinder is also clamped to the chuck by means of straps.

In the second operation the only tooling used on the turret consists of a head similar to that used in the third step of the first operation for counterboring and chamfering the bore and finish-turning and finish-facing the flange. However, rough-turning and rough-facing cuts are first taken on this flange with tools on the side carriage. While these roughing cuts are in progress, the overhanging end of the cylinder is supported by a pilot bushing from the turret, the turret having been fed forward to suit. When the roughing steps are completed, the turret is fed forward to finish the job.

Producing Large Worm Quill

Another job on which the machining time has been remarkably reduced is the large steel worm quill forging shown rough at the left in Fig. 4, and finished at the right, as it comes from the turret lathe. A worm thread is later cut on the large diameter portion near the middle of the part. The turret lathe operation consists of turning and facing the part all over and boring and counterboring, as shown in Fig. 2. One of the unusual steps is the feeding of a 3¼-inch drill through the solid forging. When machined by the methods previously used, the time per piece was nine hours, whereas, by the present method of handling on a Libby turret lathe, the time has been reduced to 1 hour 35 minutes. The piece is almost 19 inches long, 8¾ inches in diameter at the large end, and weighs about 175 pounds.

The method of chucking the forging for the preliminary steps is shown in Fig. 5. Three hardened jaws within the chuck grip the work just in back of the large worm diameter, and three cup-end set-screws in the hub of the driving plate are tightened on the worm portion to give further support. The driving plate is centralized on the chuck proper. In the first step end *A*, Fig. 2, is rough-faced by a tool on the side carriage, and then the 3¼-inch drill is fed along the center of the forging for a depth of about 13 inches. This drill may be seen set up in Fig. 7. Simultaneously with the drilling, surfaces *B*, *C*, and *D* are turned, and surface *E* finish-faced by tools on the side carriage.

In the third step, the tools on boring-bar *Q*, Fig. 6, bore holes *F*, *G*, and *H*, Fig. 2, and face surfaces *I* and *J*. Then hole *F* is finish-bored by a tool in boring-bar *R* (Fig. 6), surface *B* is finish-turned by the overhead cutter *S*, and surface *A* is finish-faced by the long-bladed cutter *T*. In the fifth step, reamer *U* finish-counterbores hole *H*. The tooling on this side of the turret has been altered slightly from that shown in the photograph, a pilot bushing having been added which enters bore *F* to guide the reamer. This completes the steps on this end of the forging.

Final Steps on the Worm Quill

In the second set-up, the quill is seated on arbor *V*, attached to the faceplate as illustrated in Fig. 8, the arbor

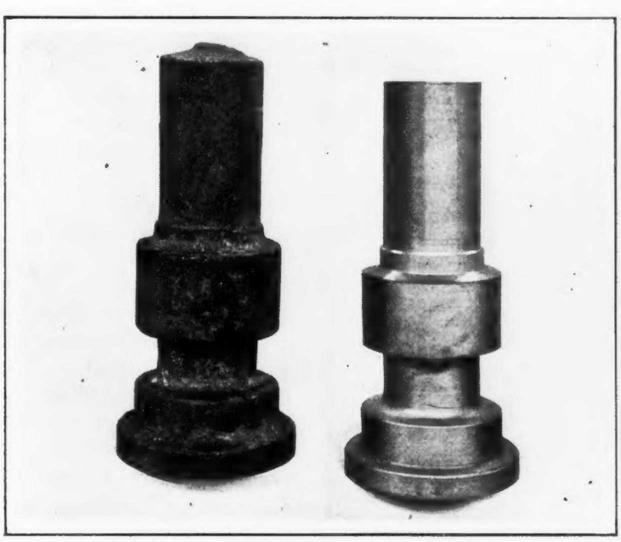


Fig. 4. The Worm Quill Forging before and after being machined

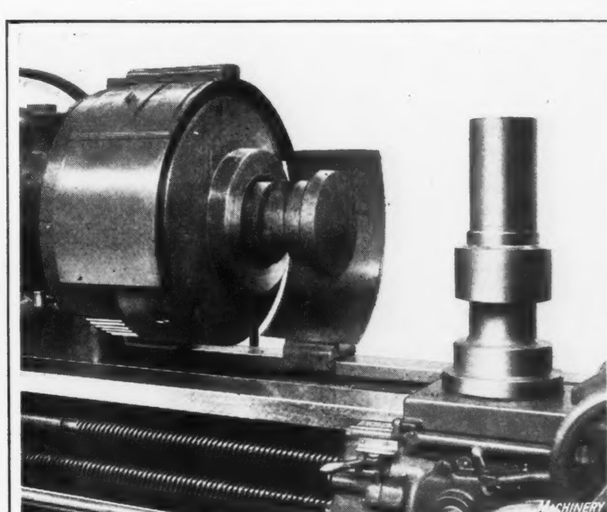


Fig. 5. Chuck Plate used to hold Worm Quill during First Operation

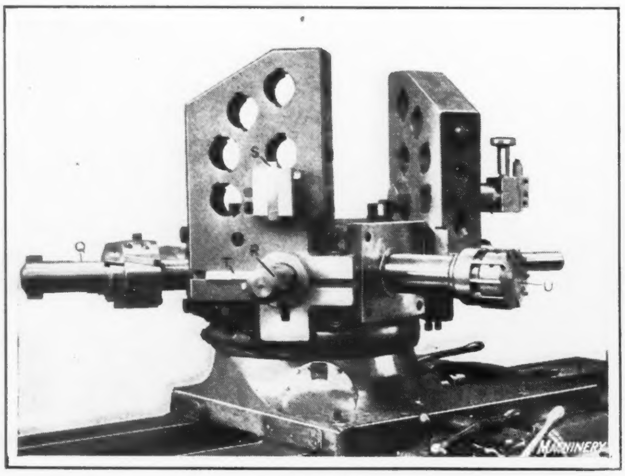


Fig. 6. Tooling Equipment provided on the Turret for the First Operation on the Worm Quill

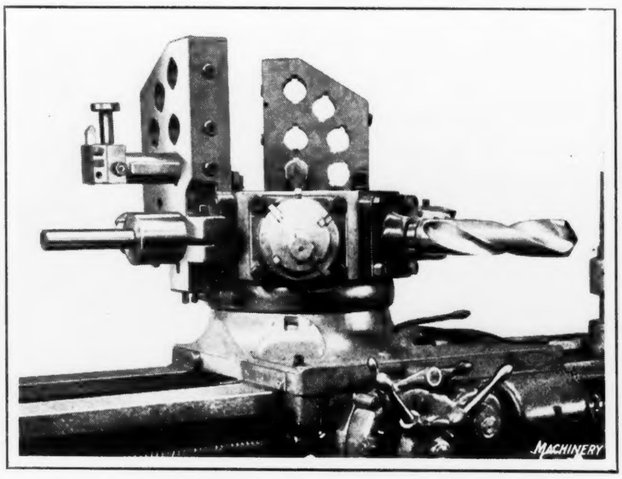


Fig. 7. Another View of the Turret Tooling Equipment for the First Operation

having two cylindrical portions which register with the previously finished bore *F*, Fig. 2, and a third cylindrical surface on which counterbore *H* is seated. The chuck has soft jaws which grip surface *B* for driving the work, and straps are used against surface *E* to hold the part to the faceplate. In the first step on this end of the quill, surface *K* is faced with a tool on the side carriage, and then the forging is drilled with the 3¼-inch drill to meet hole *L* previously drilled from the opposite end. While this step is in progress, surfaces *M*, *N*, and *O* are turned, and the adjoining surfaces faced with tools on the side carriage.

In the third step, hole *P* is rough-bored and then finish-bored, and end *K* is finish-faced by means of tools held in a vertical head on the turret. While this operation is in progress, surface *O* is finish-turned by a tool on the side carriage. The final step consists of finish-turning surfaces *M* and *N* by means of a box-tool on the turret. It is because the turret lathe permits several cuts to be taken at the same time that the machining time on this part has been so materially reduced.

* * *

THE ECONOMY OF STANDARD BEVEL GEARS

It has been pointed out by Warren G. Jones, president and general manager of the W. A. Jones Foundry & Machine Co., Chicago, Ill., that the two most important items in the cost of small quantities of bevel gears are the pattern charge and the office expense of entering the shop order and supplying the necessary information to execute the order properly. Unless standard listed gears are used, patterns must ordinarily be made, and each pair of gears requires a sketch or a drawing that will indicate the various dimensions.

Even though a manufacturer may have several thousand well assorted bevel gear patterns, not more than one out of ten existing patterns could be used without alteration. This will be appreciated if the pattern situation is analyzed. Bevel gears mesh correctly in pairs only. Consider, for example, a 16-tooth pinion mating with a 48-tooth gear, the ratio being 3 to 1. If the number of teeth in either the gear or the pinion is changed, the angles of the mating gear are immediately changed accordingly. In practice, if a pinion pattern is made for a pair of gears as mentioned, it would probably be possible to use it for a pinion having one or possibly two more (or less) teeth than 16, and still have the pinion mesh with a 48-tooth gear, but a careful check of the pattern would have to be made to determine this.

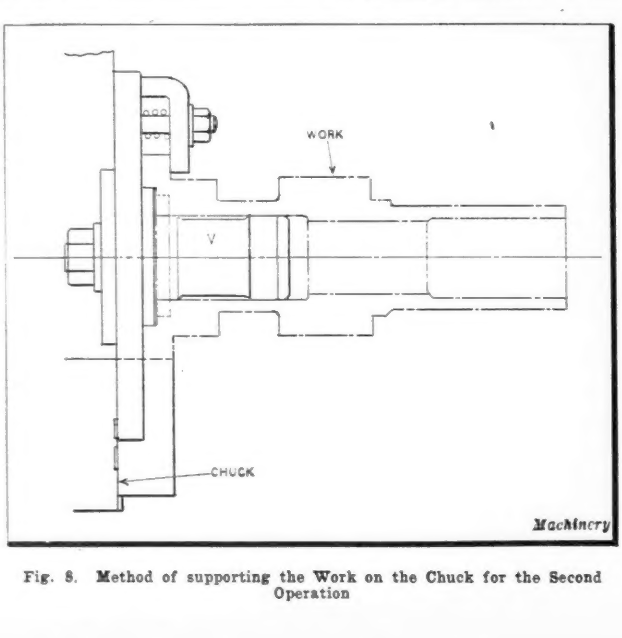


Fig. 8. Method of supporting the Work on the Chuck for the Second Operation

To carry the necessary patterns for all combinations of bevel gears, would be impractical for any gear manufacturer. By selecting listed bevel gears extra expense is eliminated, and time is also saved in filling an order.

It is usually more economical to employ rather small ratios of bevel gears, making most of the reduction, if possible, by spur gears. Bevel gears are much more expensive than spur gears, even if standard listed sizes are used.

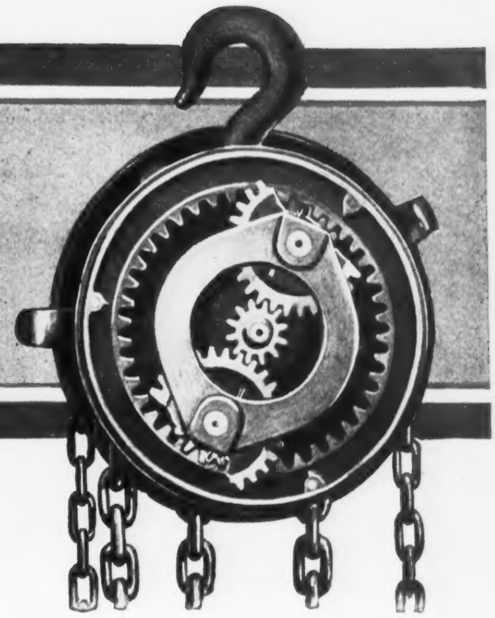
* * *

GEAR MANUFACTURERS' CONVENTION

The American Gear Manufacturers' Association will hold its ninth annual meeting at the William Penn Hotel, Pittsburg, Pa., May 6 to 9. The first day is designated as Technical Standards Day. A meeting of the general standardization committee will be held first, an address being delivered by A. H. Timmerman, president of the Electric Power Club, and afterward the different standardization committees will meet. The first general session of the meeting will be held Thursday forenoon, May 7, the meeting being opened by the president, George L. Markland, Jr., of the Philadelphia Gear Works. During the sessions that day, papers will be read on "The Development of the Gear Art," by Frank Burgess, president Boston Gear Works, Norfolk Downs, Mass.; "Limiting Spur Gear Design," by C. H. Logue, consulting engineer, Syracuse, N. Y.; and "The Application of the Photo-elastic Method to the Determination of Stresses in Gear Teeth," by Dr. A. L. Kimball, General Electric Co., Schenectady, N. Y. During the Friday and Saturday sessions papers will be read on "What Has the Automotive Gear Manufacturer Added?," by E. B. Baltzly, assistant general manager, Warner Gear Co.; "The Gear Industry on the Pacific Coast," by Frank B. Drake, president, Johnson Gear Co., Berkeley, Cal.; and "What Are the Future Possibilities in Gear Manufacturing Equipment," by F. W. England, vice-president, Illinois Tool Co., Chicago, Ill. The meeting will end with an excursion to the works of the Jones & Laughlin Steel Co.

Planetary Gearing

By FRANKLIN DeRONDE FURMAN
Professor of Mechanism and Machine Design
at Stevens Institute of Technology



Additional Examples of Planetary Gear Construction, Illustrating Interesting Modifications and Methods of Solution—Tenth Article

THE examples of planetary gear mechanisms dealt with in this article in order to illustrate further the diversified applications of the fundamental principles previously explained, include a Humpage spur planetary mechanism in which a speed reduction of 396 to 1 is obtained; the application of planetary gear principles in the construction of the 12 to 1 reduction mechanism of a watch; modification of the Fairfax planetary gear and of the Adams-Hewitt gear; planetary mechanism of a "triplex" hoisting block; and, finally, planetary mechanism giving four speeds forward and one reverse speed.

Humpage Spur Reduction Gear

The Humpage spur reduction gear is illustrated by its pitch circles in Fig. 48. The planet wheels D_3 and D_4 are keyed to the planet wheel pin G. Wheel D is the driver. The planet wheel D_3 fulcrums on the fixed wheel D_2. The planet wheel D_4 is integral with D_3 and is in gear with the internal follower gear D_1. The driving velocity AB at A is changed to a linear velocity PE at the point P of the planet wheel mass; consequently, point P of the follower wheel has a velocity also represented by PE and this, reduced to unit radius for comparison with AB in terms of angular velocity, gives AF. Then $N = \dfrac{AB}{AF}$. With the drawing made accurately to scale, $N = 396$. (The notation used throughout this series will be found at the end of this article.)

The analytical solution for the Humpage spur reduction gear is found by substituting the values of the pitch circle diameters, or the numbers of teeth in the respective gears, in the formulas already developed. The driving pinion D has 20 teeth, the internal follower wheel 99 teeth, the internal fixed wheel 100 teeth. The planet wheels D_3 and D_4 have 40 and 39 teeth, respectively.

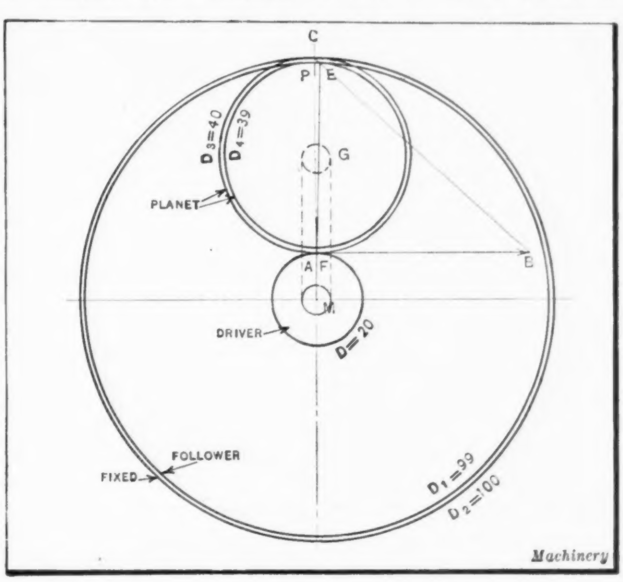


Fig. 48. Humpage Spur Type of Reduction Gear

The number of turns of the driving wheel D for one turn of the train arm is as follows:

$$N_1 = 1 + \frac{D_2}{D_3} \times \frac{D_3}{D}$$

$$= 1 + \frac{100}{40} \times \frac{40}{20} = 6$$

The number of turns of the follower wheel D_1 for one turn of the train arm is:

$$N_2 = 1 - \frac{D_2}{D_3} \times \frac{D_4}{D_1} = 1 - \frac{100}{40} \times \frac{39}{99} = 1 - \frac{195}{198} = \frac{3}{198}$$

$$N = \frac{N_1}{N_2} = 6 \times \frac{198}{3} = 396$$

In other words, it requires 396 turns of the driving shaft to produce one turn of the follower shaft.

Application of Planetary Gearing to Hands of a Watch

In the Waterbury watch, the minute hand H, Fig. 49, is fastened to the end of a shaft G which is rotated once an hour by means of a coil spring and release mechanism located in part in the box T. This box serves as the driving train arm for the planet wheel pin Q. The planet wheel D_4 rolls on the stationary wheel D_2. There are 8 teeth on D_4 and 44 teeth on D_2. The planet wheel D_3, which is integral with D_4 also has 8 teeth, and its mating wheel D_1 has 48 teeth. Obviously, the pitch of the teeth on wheels D_3 and D_4 must be different from that of the teeth on D_1 and D_2. The hour hand K is connected by a hollow shaft with the wheel D_1. The problem is to show that the hour hand K makes one-twelfth of a turn while the minute hand makes one turn.

The graphical solution of this problem is a combination of the principles and methods employed and fully explained in Problems Nos. 7 and 15 in Articles 3 and 5 of this series. (See October and December, 1924, MACHINERY.) Briefly, they are applied in the present problem as follows: Pitch circles for wheels D_1 and D_3, which work together, are drawn to a suitable scale in Fig. 49, D_1 being 48 units and D_3 8 units in diameter. The pitch circles representing wheels D_2 and D_4 will not meet if their diameters are laid out in the ratio of 44 to 8, as given in the data, so they must be recomputed, for the purpose of carrying out the graphical construction, as follows: r_2 = new radius for D_2; r_4 = new radius for D_4. Then $r_2 + r_4 = 28$ = the sum of the radii of D_1 and D_3 (1) and $r_2 : r_4 :: 22 : 4$ (2) because the new radii must be in the same proportion as the old radii, or as the old numbers of teeth.

From Equation (2),

$$r_2 = 11/2 \times r_4.$$

Substituting this value of

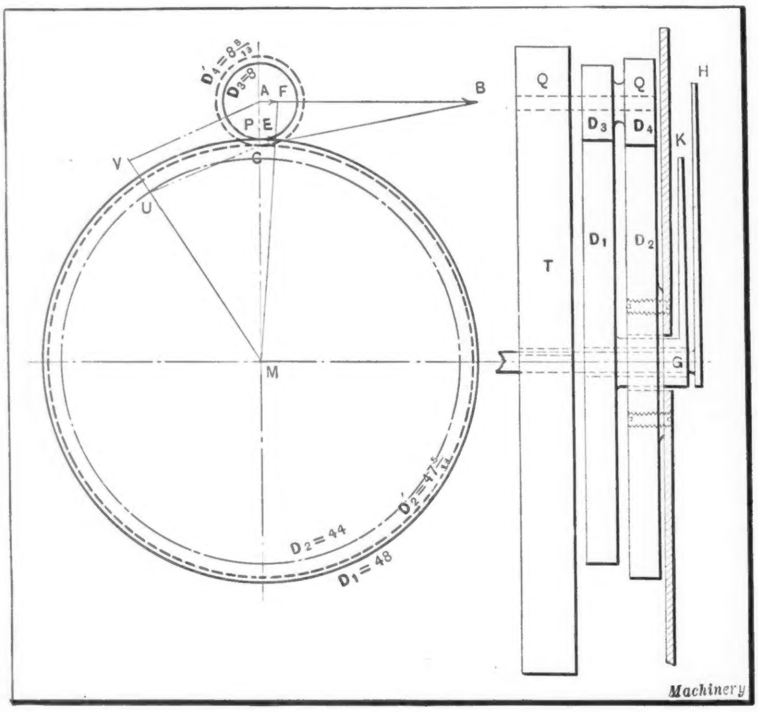


Fig. 49. Application of Planetary Gearing to Hands of a Watch

r^3 in Equation (1), we have:

$$11/2 \times r_4 + r_4 = 28, \text{ or } r_4 = 4\ 4/13$$

Substituting the latter value in Equation (1), $r_2 = 23\ 9/13$. Draw the new pitch circles for D'_2 and D'_4 with radii of 23 9/13 and 4 4/13 inches, respectively, and proceed with the construction of the velocity lines, as shown at AB, CB, PE, and MF in order. If the work has been accurately done, AB will measure 12 inches, AF one inch; hence

$$N = \frac{AB}{AF} = 12, \text{ or } N' = \frac{1}{12}.$$

Therefore the amount the follower, or hour hand K, will move while the minute hand is making one revolution is 1/12 of a turn. The determination of the new sizes for the pitch circles of wheels D_2 and D_4 may be found graphically, if desired, instead of by the arithmetical computation just made, by drawing the radial line MV in any direction, laying off the distance $MU = 44$ and $UV = 8$, drawing VA, and finally drawing UC parallel to VA, thus locating the point C and the new radii MC and AC.

The analytical solution for the preceding problem does not require a revision of sizes of the wheels D_2 and D_4, for the reason that only ratios are used in the analytical formula and the ratio of $\frac{22}{4}$ representing the original radii of these wheels is the same as the ratio $\dfrac{23\frac{9}{13}}{4\frac{4}{13}}$ which are the new radii. Therefore the general formula $N' = 1 - \frac{D_2}{D_4} \times \frac{D_3}{D_1}$ may be used and the original values substituted, even if the two pairs of wheels have different circular pitches. Thus

$$N' = 1 - \frac{44}{8} \times \frac{8}{48} = \frac{1}{12}$$

Three Reductions in One Direction with Driver Running in Opposite Direction

A reducing and reversing gear similar in principle but different in proportions to the Fairfax gear, is shown in Fig. 50. It gives three reductions in speed, all in the same direction, although the driving motion is in the opposite direction. The drive shaft S whose center is at M, has keyed to it the train arm TR and this, in turn, carries the pin R to which are fastened the four planet wheels D_3, D_4, D_5, and D_6. For a large reduction in speed, a band, represented at G, is tightened against the large internal gear wheel D_2. With the latter wheel held stationary the planet wheel D_4 rolls on it and carries the planet wheel D_3 with it; then D_3 transmits motion to the follower internal gear wheel D_1, the hub of which is shown at Q. For this reduction, the planet wheels D_5 and D_6 which are also fastened to the planet wheel pin, give their motion to the internal gear wheels D'_2 and D''_2, but these wheels then turn as idlers because they are not gripped by the holding bands G_1 and G_2.

The graphical construction for this reduction gear is also shown in Fig. 50. The pitch circles for the gear wheels are laid out in the proportions they would have if the wheels had the following numbers of teeth all of the same pitch: $D_1 = 90$ teeth; $D_2 = 84$; $D'_2 = 80$; $D''_2 = 75$; $D_3 = 30$; $D_4 = 24$; $D_5 = 20$; and $D_6 = 15$. Then if AB represents the velocity of the driver and also the velocity of the planet wheel centers, and if C on the wheel D_2 is the fulcrum point of the stationary wheel D_2, then C on the planet wheel D_3 must be the center of turning of that wheel, and the point P must turn with the velocity PE. This is also the velocity of the internal follower wheel, and when reduced to the unit radius MA, is AF in the opposite direction to AB. Therefore

$$N = \frac{AB}{-AF}.$$

If drawn accurately to scale, AB equals 12 units and AF 2 units, whence $N = \frac{12}{-2} = -6$; in other words, the driver shaft S makes six turns clockwise while the follower shaft Q makes one turn in the opposite direction. This result is obtained analytically by substituting the numbers of teeth on the respective wheels in the following general formula:

$$N' = 1 - \frac{D_2}{D_4} \times \frac{D_3}{D_1} = 1 - \frac{84}{24} \times \frac{30}{90} = -\frac{1}{6}, \text{ or } N = -6.$$

For obtaining the next reduced speed, the band G_1 is drawn tightly against the internal spur wheel D'_2, thus compelling planet wheel D_5 to carry the load, and allowing D_4

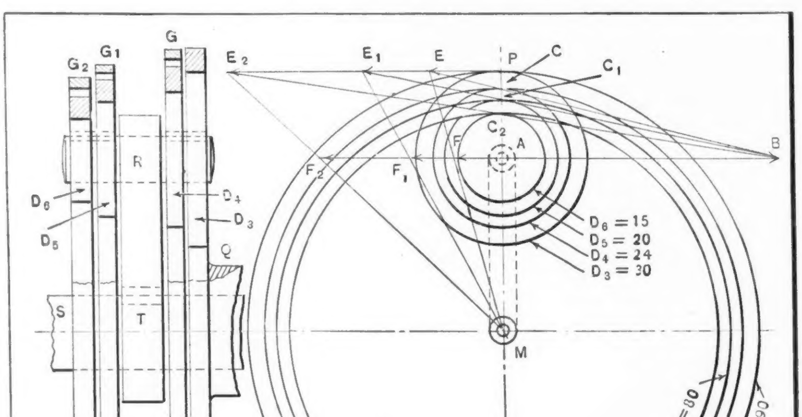


Fig. 50. Planetary Mechanism which gives Three Reductions in One Direction with Driver running in Opposite Direction

and D_5 to simply turn their respective sun wheels idly, as the bands G and G_2 are automatically released when the band G_1 is tightened. The graphical solution for the next lowest speed is shown at AB, BE_1, E_1M, and AF_1, and is expressed as $N = \frac{AB}{-AF_1} = \frac{12}{-4} = -3$. The analytical solution for this second case is identical in method to that shown for the first reduction. The third reduced speed in the problem is found in the same way as described for the two previous speeds, and in this case, $N = -1.5$. Summing up, it will be noted that the proportions in this problem give reductions of $\frac{1}{6}$, $\frac{1}{3}$ and $\frac{2}{3}$ all in the opposite direction to that of the driver

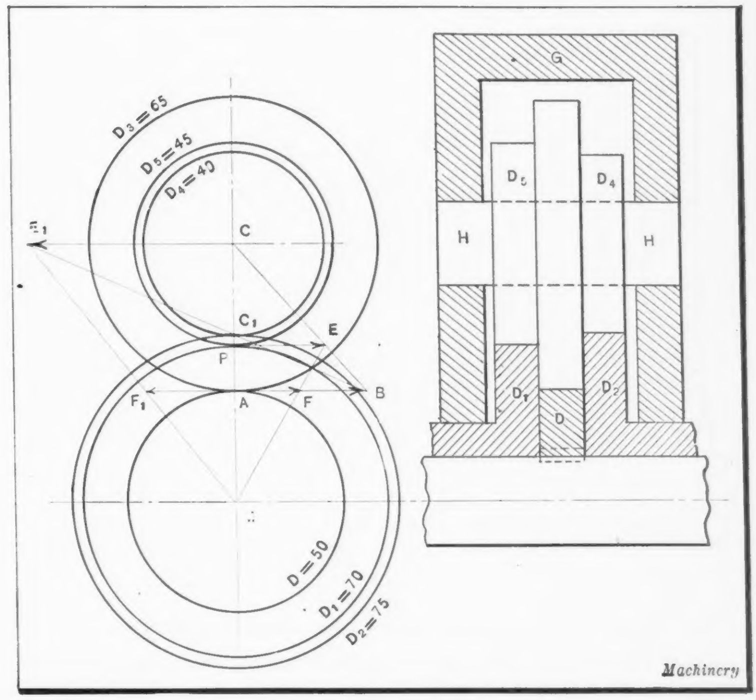


Fig. 51. Mechanism providing Two Forward Speeds and One in Reverse

Planetary Gearing for Obtaining Two Forward Speeds and One in Reverse

A simple and compact type of planetary gear that gives two forward speeds and one reverse is shown in diagrammatic form in Fig. 51. This is a modification of the Adams-Hewitt gear. Although of a pronounced planetary form of construction, it is used as a direct planetary gear in only one of its three motions. The driving wheel D has 50 teeth, the follower wheel D_1, 70 teeth, the fixed wheel for reverse D_2, 75 teeth, and the planet wheels D_3, D_4, and D_5 have 65, 40, and 45 teeth, respectively. Full speed forward is obtained by locking the entire mechanism so that it revolves as one solid piece. For second speed forward, the rotating gear-box G is held stationary, and for reverse, D_2 is held stationary.

The solution for second speed is the same as for a simple train of gears with fixed centers, since the planet wheel pin H is held in one position. The graphical solution would therefore be as shown at AB, BC, PE, and AF; hence

$$N = \frac{AB}{AF}$$

In the analytical solution, the first term which consists of the numeral 1 in the standard formula on gears that have a planetary action, will naturally be omitted in this case, and

$$N = \frac{D_1}{D_5} \times \frac{D_3}{D} = \frac{70}{45} \times \frac{65}{50} = \frac{91}{45} = 2\frac{1}{45}$$

The graphical solution for the reverse speed is indicated in Fig. 51 by the lines AB, BE_1, E_1M and AF_1; whence

$$N = \frac{AB}{-AF_1}$$

Using the standard formula for the analytical solution:

$$N = 1 - \frac{75}{40} \times \frac{65}{50} = 1 - \frac{39}{16} = -1\frac{7}{16}$$

Planetary Gearing of Hoisting Block

A well-known example of planetary gearing as applied to hoisting work is the Yale & Towne triplex hoisting block, illustrated diagrammatically in Fig. 52. The pure planetary action is of a simple nature, being similar to the problems in Group 1 in the earlier part of this series. The operation of the hoist is, briefly, as follows: By pulling on the endless chain which runs over the pulley H, the shaft I and the driving spur pinion T are turned. The shaft I turns freely in all other bearings and sleeves. The pinion T causes the planet wheel mass, which is composed of toothed wheels T_3 and T_4, to turn as one solid piece about the tooth C of the fixed internal gear wheel T_2. This turning gives a motion to the planet wheel pin P and drives the train arm R which is keyed to the sleeve L. This sleeve is a rigid part of the drum that carries the heavy chain to which the load W is attached. The wheels T and T_3 have 12 and 29 teeth, respectively, and the wheels T_2 and T_4 have 42 and 11 teeth, respectively. The teeth on the latter two wheels are of coarser pitch than those on T and T_3.

The graphical solution for the triplex hoist requires that the pitch circles of all wheels must be reduced to a common pitch before they can be drawn. In this case, T_2 and T_4 will be drawn to any desired scale, with their diameters proportional to 42 and 11, respectively. The pitch circle radii for wheels T and T_3 are then computed on the basis that the radius r of T, plus the radius r_3 of T_3, must be equal to the radius r_2 of T_2 minus the radius r_4 of T_4, all because the distance between the center lines of the shaft and planet wheel pin must be a constant for all interacting combinations of wheels that are mounted on these members. Also, when the new pitch diameters for T

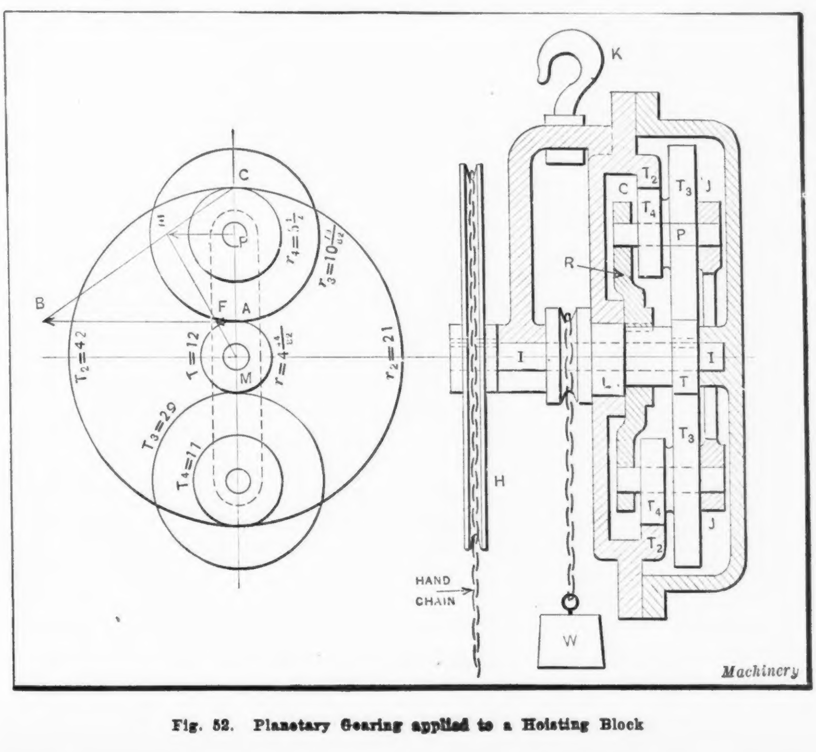


Fig. 52. Planetary Gearing applied to a Hoisting Block

and T_3 are found, they must be in the ratio of the assigned relative sizes as given in the data in the previous paragraph, or, as 12 to 29. From these considerations: $r + r_3 = 21 - 5.5 = 15.5$, and $r : r_3 :: 12 : 29$. From these equations

$$r = 4\frac{44}{82} \text{ and } r_3 = 10\frac{79}{82}$$

and these values are used in drawing the circles of wheels T and T_3. The graphical construction is indicated at AB, BC, PE, and AF. Then

$$N = \frac{AB}{AF}$$

Analytically, the problem is readily solved as explained in Article 5 of this series without any recomputation of the pitch circles, because the new sizes would be in the same *ratio* as the original numbers given in the data and therefore would not affect the result given by general formula

$$N = 1 + \frac{T_2}{T_4} \times \frac{T_3}{T}$$

$$= 1 + \frac{42}{11} \times \frac{29}{12}$$

$$= 10\frac{5}{22}$$

or, in other words, it takes $10\frac{5}{22}$ turns of the hand chain pulley H to produce one turn of the load chain drum L. Both turn in the same direction so that it should be noted that the hand chain H and the load chain drum L are stressed from opposite sides of the center of the block in order that a downward pull on the hand chain may produce an upward pull on the object being lifted.

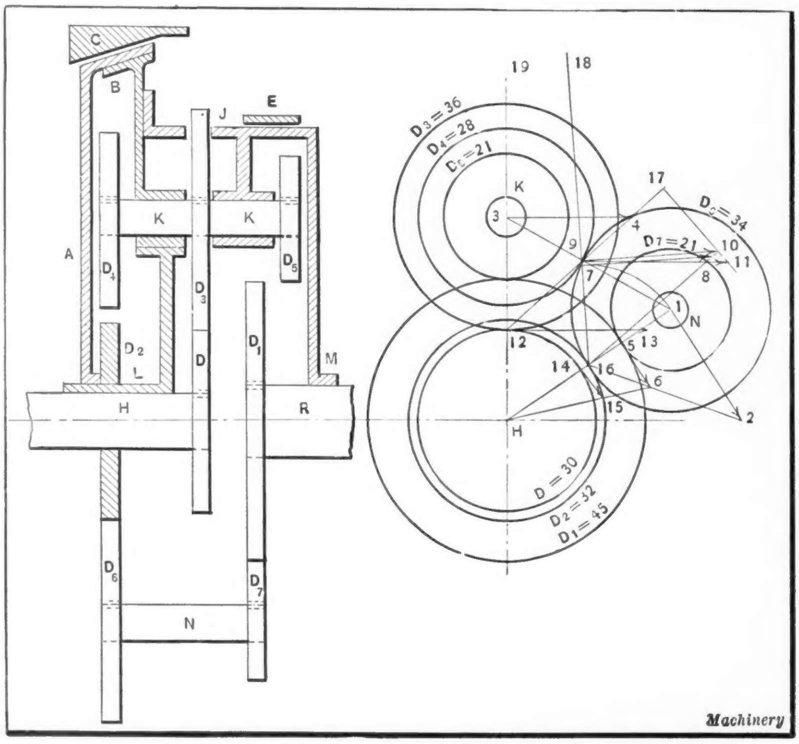


Fig. 53. Mechanism giving Four Speeds Forward and One in Reverse

Mechanism Giving Four Speeds Forward and One in Reverse

A planetary mechanism giving four speeds forward and one speed in reverse is illustrated diagrammatically in Fig. 53. The driving shaft H carries the sun wheel D which gears with planet wheel D_3. The planet wheels D_3, D_4, and D_5 are rigidly keyed to the spindle K which is carried by the cage J and this, in turn, is carried by sleeves L and M which are loosely mounted on the driving and follower shafts H and R. The spindle N carrying the planet wheels D_6 and D_7 is shown at the bottom of the view for the sake of avoiding overlying projections, but in reality it is located in the upper half of the drawing so that the wheel D_6 gears with both D_2 and D_4 (as shown by the circles at the right), and the wheel D_7 gears with D_1. The wheel D_1 is a sun wheel and is keyed to the follower shaft R. The spindle N is carried by the cage J, as is also the spindle K, so that the wheels just described are in positive engagement. The clutch disk A slides on the sleeve L, and when it is pressed to the right as by a spring, it grips the cone friction surface B to which is attached the cage J. Under these conditions the entire mechanism rotates as one solid piece, and there is "direct drive."

If the clutch disk A is moved to the left so as to grip the fixed internal conical surface at C, the sun wheel D_2 will be held stationary, and the drive will be through D and D_3, D_4, D_6 and D_7 with D_6 using D_2 as a fulcrum. The number of teeth in each gear wheel is as follows: $D = 30$; $D_1 = 45$; $D_2 = 32$; $D_3 = 36$; $D_4 = 28$; $D_5 = 21$; $D_6 = 34$; and $D_7 = 21$. To more readily solve this by the analytical method, the pitch circles of the sun and planet wheels of the mechanism are represented in their proper relative proportions and positions by the circles at the right of Fig. 53. According to notation and methods used in previous problems:

$$N_1 = 1 + \frac{D_2}{D_6} \times \frac{D_6}{D_4} \times \frac{D_3}{D} = 1 + \frac{32}{34} \times \frac{34}{28} \times \frac{36}{30} = \frac{83}{35}$$

$$N_2 = 1 - \frac{D_2}{D_6} \times \frac{D_7}{D_1} = 1 - \frac{32}{34} \times \frac{21}{45} = \frac{143}{255}$$

$$N = \frac{N_1}{N_2} = \frac{83}{35} \times \frac{255}{143} = 4.23$$

Therefore, it takes 4.23 turns of the drive shaft H to give the follower shaft R one full turn.

The graphical solution for this case is similar in principle to the graphical solutions explained in connection with Fig. 35 in Article 8, but in the present problem the lines 9-18, Fig. 53, and 3-19 which are perpendicular to 9-10 and 3-4, respectively, meet at some point outside of the illustration, so that the instantaneous axis of the planet wheel D_4 cannot be located or used, and another method must be followed. Assume that the follower D_1 is moving with a velocity 5-6. This will cause the planet wheel D_7 to pivot against the teeth on the fixed wheel D_2 at 16, and drive the spindle N with a velocity 1-2. Spindles N and K must have the same linear velocities, since they are both fastened to the same cage and at the same distance out. Therefore the velocity 3-4 at K equals 1-2 at N. Since the wheel D_6 has the point 16 as its instantaneous axis, the point 9 of this wheel must be moving at right angles to the line 16-9 and with a velocity 9-10 found by making the angle 9-16-10 equal to the angle 1-16-2. This velocity 9-10 of the wheel D_6 will also be the velocity of the point 9 of the wheel D_4, inasmuch as both D_4 and D_6 are in pure rolling action (no sliding) at the point 9.

At this point, the simplest method of procedure would be to locate the instantaneous axis of the wheel D_4 at the junction of lines 18 and 19, but as this is not feasible, the following method, based on principles used in the construction of velocity diagrams is followed: Draw line 12-9 and continue it; perpendicular to this line draw another line through 10 and continue it until it meets a horizontal line through 9. In this way, the line 9-11 is determined, which is equal to the linear velocity 12-13 of the driving wheel D when the follower wheel has a linear velocity of 5-6 which was assumed at the start. In order to compare angular velocities of the driver and follower wheels, the linear velocity 5-6 of the follower will be reduced to its corresponding velocity of 14-15 when taken at the radius H-12 which is the radius of the driver's pitch circle. From the graphical construction, then,

the answer to the problem may be written $N = \frac{12\text{-}13}{14\text{-}15}$.

Measuring these lines (12-13 and 14-15), the answer N = 4.23 is found if the drawing is accurately made.

Solutions Applied to Reverse Movement of Mechanism Shown in Fig. 53

For the reverse gear of the four forward-speed mechanism shown in Fig. 53, the clutch disk A is moved slightly to the left from the position shown so that it is out of contact with both B and C. At the same time the band E is automatically tightened on the cage J thus holding it and the axis of the planetary spindles K and N in one position. The action under this condition is through the wheels D and D_3, D_4 and D_6, and D_7 and D_1. The wheel D_2 turns as an idler. Following the path of the driving action and noting that there is no planetary action in this problem because the axis of the

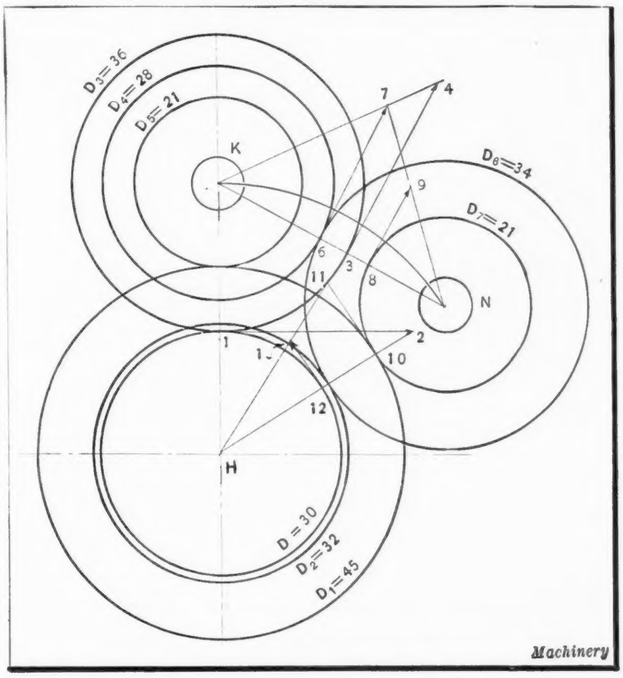


Fig. 54. Graphical Solution of Reverse Action of Mechanism shown in Fig. 53

planet wheel spindles remain stationary, the following formula may be written:

$$N' = \frac{D}{D_3} \times \frac{D_4}{D_6} \times \frac{D_7}{D_1} = \frac{+30}{-36} \times \frac{-28}{+34} \times \frac{+21}{-45} = -\frac{49}{153}$$

$$N = \frac{1}{N'} = -\frac{153}{49} = -3.12$$

This result shows that it takes 3.12 turns of the driving shaft H to produce one turn of the follower shaft R in the opposite direction.

The graphical solution for the reverse gear action of the problem stated in the preceding paragraph is illustrated in Fig. 54. **The initial driving velocity is 1-2 to which 3-4 is** made equal. The wheel D_4 will then have the linear velocity 6-7, the wheel D_7 the velocity 8-9, and the wheel D_1 the velocity 10-11 which is equal to 8-9. Since D_1 is the follower wheel, the velocity is reduced to the value 12-13 at the radius H-1 of the driver, when the two velocities 1-2, which is clockwise, and 12-13, which is counter-clockwise, may be directly compared in terms of revolutions per minute and the following formula written:

$$N = \frac{+1\text{-}2}{-12\text{-}13}$$

Measuring the lengths of these lines and substituting, it will be found if the drawing is accurately made, that N = — 3.12.

Determining Additional Speed Ratios of Mechanism Shown in Fig. 53

The two remaining speeds given by the four forward-speed planetary transmission (Fig. 53) are obtained by sliding the horizontal shaft R to the right so that the sun gear wheel D_1 is brought into contact with the planet gear wheel D_5. For the first of these two speeds, the disk clutch plate A is then moved to the left so that it is in frictional contact with the fixed friction cone C, in which case the sun wheel D_2 is held stationary and becomes a fulcrum for the planet wheel D_6 which transfers the motion to D_4. For the second of the two speeds, the friction disk A is moved slightly to the right so as to be out of contact with both the cones C and B, and at the same time the stationary friction band E is tightened on the cylindrical drum surface of cage J, thus holding the axis of the spindle K stationary.

The analytical solution for the first of the two speed arrangements described in the preceding paragraph is made

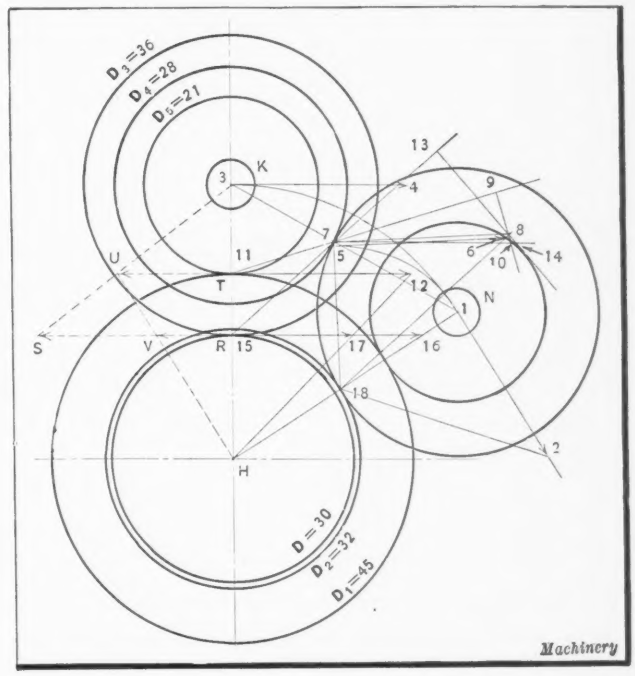


Fig. 55. Another Application of Graphical Method to Mechanism shown in Fig. 53

by considering that the drive is through the gear wheels D and D_3, D_4 and D_6, D_6 and D_2, and D_5 and D_1. Then

$$N_1 = 1 + \frac{D_2}{D_6} \times \frac{D_6}{D_4} \times \frac{D_3}{D} = 1 + \frac{32}{34} \times \frac{34}{28} \times \frac{36}{30} = \frac{83}{35}$$

$$N_2 = 1 + \frac{D_2}{D_6} \times \frac{D_6}{D_4} \times \frac{D_5}{D_1} = 1 + \frac{32}{34} \times \frac{34}{28} \times \frac{21}{45} = \frac{69}{45}$$

$$N = \frac{N_1}{N_2} = \frac{83}{35} \times \frac{45}{69} = 1.55$$

The graphical solution that corresponds with the analytical solution given in the preceding paragraph is illustrated in Fig. 55. In this solution, it is more convenient to start with an assumed velocity, such as 1-2, of the cage or planet wheel axis at N and find the corresponding velocities of the driver, as at 15-16, and of the follower as at 15-17. Outlining the construction briefly: Draw 18-7 and on it lay off 18-5 equal to 18-1. Make 5-6 equal to 1-2. Draw 18-6 and extend it to meet 7-8, which latter line is perpendicular to 18-7. Draw 11-7 and extend it so that a line 8-9 may be drawn through 8 perpendicular to it. Continue the line 9-8 until it meets a horizontal line drawn through 7, thus obtaining the line 7-10. Transfer 7-10 to 11-12, and this will be the linear velocity of the follower wheel at its pitch circle. Reducing this velocity to the radius of the driving wheel so that the angular velocities may be compared finally, 15-17 is obtained. The velocity 15-16 of the driver is ob-

tained by drawing 15-7 and continuing it so that a line through 8 may be drawn perpendicular to it. This perpendicular line is 13-8 which, continued, cuts the horizontal line through 7 into the length 7-14. This length represents the linear velocity of the driver's pitch circle and is transferred to 15-16. The answer to the graphical solution may now be written as $N = \frac{15\text{-}16}{15\text{-}17}$. If these distances are measured, assuming that the drawing is accurately made. $N = 1.55$.

The analytical solution for the second of the two speed arrangements previously described is made by considering that the drive is through the gear wheels D and D_2 and D_5 and D_1, Figs. 53 and 55, there being no planetary action, and the wheels D_4, D_6, D_3, and D_7 running idle. Under these conditions,

$$N = \frac{+D_1}{-D_5} \times \frac{-D_2}{+D} = \frac{45}{21} \times \frac{36}{30} = 2.57$$

The graphical solution for the case described in the preceding paragraph is the simplest of all the five cases involved in the four-speed forward and one reverse speed mechanism under discussion. For the present case the driving wheel has a linear velocity represented by RS in Fig. 55. Since the planet wheel spindle axis is stationary, the planet wheels all have an angular velocity represented by the angle RKS, and the pitch circle of the planet wheel D_5 has a linear velocity TU. This is also the linear velocity of the pitch circle of the follower, and when this velocity is reduced to correspond to the radius of the driver, it is RV. Hence,

$$N = \frac{RS}{RV}$$

If these values are measured, and if the drawing is accurately made, $N = 2.57$.

Notation

N = number of turns of driver to one of follower or driven member;

N' = number of turns of follower to one of driver;

N_1 = number of turns of driver to one complete revolution of planet wheel axis;

N_2 = number of turns of follower to one complete revolution of planet wheel axis;

D = diameter of pitch circle of driver, if driver is a toothed wheel; (The driver, or the follower, may be the "train arm" and not one of the toothed wheels, according to the data of a problem.)

D_1 = diameter of pitch circle of follower, if follower is a toothed wheel;

D_2 = diameter of pitch circle of fixed wheel;

D_3, D_4, etc., = diameters of pitch circles of planetary wheels;

T = number of teeth on driver, if driver is a toothed wheel;

T_1 = number of teeth on follower, if follower is a toothed wheel;

T_2 = number of teeth on fixed wheel; and

T_3, T_4, etc., = number of teeth on planetary wheels.

* * *

FOREIGN TRADE CONVENTION

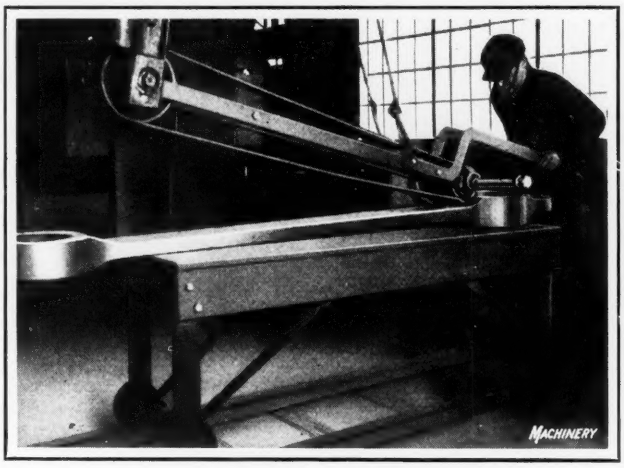
The twelfth national foreign trade convention will be held at Seattle, Wash., June 24 to 26. In addition to delegates from every part of the United States, there will be a number of business men present from Japan, China, India, the Straits Settlements, the Dutch East Indies, and the Philippines. In issuing the call to the convention, James A. Farrell, chairman of the National Foreign Trade Council, states that the foreign trade of this year gives promise of exceeding that of 1924. There is a new assurance of stability and progress in Europe, and increasing activity in the countries across the Pacific, as well as in South America and other overseas markets.

EQUIPMENT FOR GRINDING LOCOMOTIVE RODS

By NORMAN C. McLOUD

The handling of various locomotive parts has been simplified in the Glenwood shops of the Baltimore & Ohio Railroad, through the use of the device here illustrated, which was produced by the local Efficiency Bureau of the road. The device is in the form of a swinging buffer and grinder, and is used chiefly for grinding and polishing the surfaces of locomotive rods. With the methods formerly used, two or three men were required to handle rods on the stationary table. The strain on the operators, when using the old method, was considerable, as the short radius of the buffer and grinder made it necessary for the men to rock the side-rods backward and forward over the table, in order to finish all the surfaces.

The new method involved the installation of a portable table which is now in constant use. The table is equipped with flanged wheels that run on light-weight rails. When a rod has been placed on the table, it is not moved until the entire surface on one side has been polished, a result accomplished by moving the table backward and forward. The rod is turned over for polishing the other side by using



Grinding Locomotive Rods

a bar as a lever, the bar being inserted through the bushing hole. The new outfit finds favor with the workmen, and enables the entire job to be performed by one man in one-half the time previously required.

* * *

HOW THE AUTOMOBILE HELPS THE RAILROADS

Reference has frequently been made to the fact that the business created for the railroads by the automotive industry offsets that taken away by automobiles and buses. In 1924, 726,000 carloads of finished automobiles and parts were shipped by rail. In addition, there were 50,000 carloads of tires and 640,000 tank carloads of gasoline for automobile use. The coal, steel and other raw materials used in the manufacture of automobiles also added a great many tens of thousands of carloads for which separate figures are not available. Inasmuch as the automobile is wholly responsible for the activity in high-grade road building, the 550,000 carloads of cement, much of which went into roads and highway bridges should also be considered as a direct result of the automobile industry. The National Automobile Chamber of Commerce estimates that if complete data were available, approximately 2,000,000 carload shipments should be credited to the automobile industry. An appreciation of what these figures mean can best be had from a comparison with other commodities. In 1923 the wheat crop, which has always been considered a barometer of railroad prosperity, required 572,000 carloads, and the corn crop, 400,000 carloads.

Notes and Comment on Engineering Topics

Sixty-five per cent of the upholstery leather manufactured in the United States is used in upholstering automobiles.

The traffic through the Panama Canal is constantly increasing. Ten years ago the total tonnage passing through the canal was less than 5,000,000 tons. In 1920 it was less than 10,000,000 tons, while in 1924 it was nearly 27,000,000 tons.

The copper production during 1924 broke all previous peace records, according to a statement issued by the Department of the Interior, being 13 per cent over the production in 1923, which was the highest record for any year except some of the war years.

Fibrous materials, such as micarta, have recently been used for airplane propellers, supplanting wood and forged duralumin. The micarta propellers are said to have proved of greater tensile strength than wood, and they have far greater crushing strength edgewise than the latter material for the same weight.

Experiments with an electric furnace for the purpose of making steel from the ore are being carried on by one of the established iron and steel works in Sweden, Uddeholmsverket. The product that has been obtained so far, according to recent reports, is a good quality, equal, if not superior, to Bessemer steel.

An interesting case of saving by means of stamping is recorded in the case of an oil-pan for an automobile, formerly made at the cost of $7.32 for an aluminum casting, exclusive of the machining cost. If as many as 15,000 are made, these can be stamped out at the cost of $1.25 a piece, including tool costs; the stampings require no further machining.

Statistics covering the shipbuilding industry of the world during 1924 show that of the total tonnage built—2,250,000 tons—Great Britain supplied considerably more than one-half, or 1,440,000 tons. Germany launched the next largest tonnage of 194,000 tons. The United States, including both coast and Great Lake shipping, launched nearly 140,000 tons, Italy following with 82,500 tons.

Carborundum is now being used as a detector unit for radio receivers of the reflex and crystal types. This new unit is of the cartridge form and is made of carborundum especially manufactured and tested for radio use. The unit is fixed and permanent, adjustments being unnecessary. This detector is said to remain sensitive indefinitely and will not burn out. Tests have proved that the carborundum detector unit makes possible the reception of clear true tones, with excellent selectivity, volume, and distance when used in any properly constructed reflex or crystal set.

By means of instantaneous illumination at high speeds it has been found possible to photograph airplane propellers running at a speed as high as 11,000 revolutions per minute. As an interesting test of the possibility of photographing an object at this high speed, a silk thread fastened to the propeller blade was photographed at rest, and again, when illuminated by the instantaneous method devised for the purpose, with the blade making 11,000 revolutions per minute. The photograph of the silk thread at this high speed showed it but a little thicker than the photograph of the thread at rest.

If there were as many automobiles in use in proportion to population throughout the United States as there are in California, there would be 40,000,000 cars in this country, instead of 16,000,000. It is estimated that the average life of a car is over eight years. Hence, when the United States as a whole comes to use automobiles at the rate that California does, it will take 5,000,000 new cars a year to replace those worn out and discarded. Last year 3,500,000 new cars and trucks were produced, and it is quite possible that the future will see the industry grow until 5,000,000 cars will be turned out annually.

There are more telephones in proportion to population in the United States than in any other country in the world. The other leading countries in the order of the number of telephones in proportion to population are: Canada, Denmark, New Zealand, Sweden, Norway, Australia, Switzerland, Hawaii, Iceland, Holland, Germany, and Great Britain. "It is somewhat surprising," says *Engineering* (London), "that Great Britain takes such an inferior position among the nations of the world in the use of the telephone." It is an interesting fact in connection with telephone service that the more universally extended this service is, the greater is the value of the telephone to each individual subscriber.

A constantly increasing use of automobile trucks by railroads is predicted by G. C. Woodruff, assistant freight traffic manager of the New York Central Railroad. In a recent address in New York City, Mr. Woodruff stated that there is a very large field for the motor truck in railroad activity —a field that has just been entered upon in a small way. Basing his conclusions upon two years of extensive and constantly extended use of motor trucks in railroad service, Mr. Woodruff is of the opinion that cooperation between railroads and established trucking agencies may aid in a more rapid and satisfactory development of railroad trucking service than could be accomplished by the railroads themselves without such aid and cooperation.

Business grows big through the service it renders, not through any "control" that it exercises over materials, money, or people. It grows through the growth of transportation and manufacture. Once every town's shoes were made in that town; manufacturing was done where the immediate market was. With railways, manufacturing became centralized. In so far as this is economically wrong, wasteful or too costly, it will correct itself. In some lines it is already correcting itself. When business becomes so big that its bigness is a tax upon the community, instead of a service to the community, the decreasing patronage of the people becomes an effective check. In some lines we are slowly treading the way back to community self-sustenance. In doing so, we abolish unnecessary processes, and lift an enormous unnecessary load off our railroads.—*Henry Ford*

LEDRITE BRASS ROD

Ledrite brass rod is a free-cutting material which is especially adapted for high-speed machining operations in connection with screw machine practice. It has long been known that the addition of a small amount of lead imparts free-cutting qualities to brass, as indicated by the fact that the chips have a tendency to break up into short pieces and thus prevent fouling the tools. This free-cutting action depends upon the fact that the lead is distributed as fine globules throughout the mass of the metal. The more thoroughly the molten metal in the melting furnace is stirred, the more finely will the lead be divided and the more evenly will it be distributed through the metal; thus greater uniformity of cutting properties results. Ledrite brass rod is one of the products of the electric furnace.

PITOT TUBE

The Pitot tube is used for measuring the velocity of fluids in motion. It consists simply of an open tube having a right-angle bend. The tube is placed in the stream of water (the pressure of which is to be measured) in such a position that one of the open ends is directed against the flow of the water while the other end projects above the surface of the water. The height to which the water rises in the end projecting above the surface is equal to the velocity head. Modifications of the Pitot tube are also used for measuring the flow of water and gases in pipes.

KILOWATT

The unit of power generally adopted for all electrical work and also frequently used in mechanical engineering is known as the "kilowatt." One kilowatt equals 1.34 horsepower, or one horsepower equals 0.746 kilowatt. The latter figure is the exact standard relationship between the kilowatt and the horsepower used by the United States Bureau of Standards, and may, therefore, be assumed as the exact equivalent of horsepower in electrical units. An effort has been made in scientific and engineering circles to substitute the kilowatt for the indefinite horsepower as the unit measurement of power. The kilowatt is just as good a mechanical unit as an electrical one, and it has the advantage of being a logical rating, expressing a definite relation to the absolute system of measurements in general use for scientific purposes. One of the advantages of the kilowatt is that it is an absolute international unit. A kilowatt in Germany, France, and the United States is the same, while that is not true of the horsepower. The latter, in countries using the metric system, is calculated as the equivalent of 75 kilogram-meters per second, which equals 542.5 foot-pounds per second, or 32,550 foot-pounds per minute—an appreciable amount less than the 33,000 foot-pounds constituting the British and American horsepower. The adoption of the kilowatt as a unit of power would avoid having generators rated in kilowatts while their driving machinery and electric motors are rated in horsepower.

COPPER CASTINGS

So-called "pure copper" castings ordinarily contain from one to three per cent of zinc. These are used in electrical installations and for die-blocks on electric welding machines. The conductivity, as compared with silver = 100, is not more than 60 per cent. Pure commercial copper containing from 99.6 to 99.9 per cent of metallic copper has a conductivity from 70 to 85 per cent of that of pure silver. Hence, the impurities in ordinary copper castings impair, to a great extent, its value as an electrical conductor.

CONCRETE MIXING WATER

The Bureau of Standards recommends the use of a small quantity of calcium chloride in the mixing water of concrete in order to hasten the hardening of the concrete. Tests showed that the addition of calcium chloride to the mixing water up to 10 per cent by weight increases the strength from 30 to 100 per cent over that of concrete in which plain water is used, and that the best results are obtained when from 4 to 6 per cent of calcium chloride is used. While calcium chloride has no harmful effect upon the concrete, it does affect iron and steel, and therefore should not be used for reinforced concrete.

CIRCUIT-BREAKERS

A circuit-breaker is a device for automatically opening an electric circuit when a predetermined abnormal condition exists in the circuit in which the circuit-breaker is connected. There are several kinds of circuit-breakers. Those in most common use are the magnetic blow-out circuit-breaker, the air- or carbon-break circuit-breaker, and the oil circuit-breaker. Circuit-breakers are generally arranged to trip under one of the following conditions or some combination of them: Overload, underload, over-voltage, low voltage, and reverse current. The automatic tripping of a circuit-breaker is accomplished by applying or releasing the power of an electromagnet which is excited by current flowing through a coil of wire, or its equivalent, surrounding at least one pole of a magnetic circuit. The magnet coils may be of either one of two classes—current or potential—depending upon the manner in which the coils are connected in the circuit.

FLANGE STEEL

So-called "flange steel," which is generally used for the heads of steam boilers, is an especially tough and ductile quality of open-hearth steel. The A. S. M. E. boiler code specifications for flange steel are as follows: Manganese, 0.30 to 0.60 per cent; phosphorus, acid, not over 0.05 per cent; basic, not over 0.04 per cent; sulphur, not over 0.05 per cent. An analysis is to be made by the manufacturer from a test ingot taken during the pouring of each melt, and a copy given to the purchaser or his representative.

WATER PRESSURE

The greatest density of water occurs at 39.1 degrees F., when it weighs 62.425 pounds per cubic foot. The pressure in pounds per square inch of water that is not moving, against the sides of any pipe, vessel, container, or dam is due solely to the "head" or vertical height of the surface of the water above the point at which the pressure is considered. The pressure is equal to 0.433 pound per square inch for every foot of the head, at a temperature of 62 degrees F. For higher temperatures, the pressure decreases slightly. The pressure per square inch is equal in all directions, downward, upward, and sideways. Water is composed of hydrogen and oxygen, in the ratio of two volumes of the former to one of the latter. It boils under atmospheric pressure at 212 degrees F. and freezes at 32 degrees F. Water can be compressed only in a very slight degree, the compressibility being so slight that, even at the depth of a mile, a cubic foot of water weighs only about one-half pound more than at the surface. The quantity of water that will be discharged through a pipe in a given time depends primarily upon the head and also upon the diameter of the pipe, the character of the interior surface, and the number and shape of the bends.

FATIGUE STRESSES

So-called "fatigue ruptures" occur in parts that are subjected to continually repeated shocks or stresses of small magnitude. Machine parts that are subjected to continual stresses in varying directions, or to repeated shocks, even if of comparatively small magnitude may fail ultimately if designed, from a mere knowledge of the behavior of the material under a steady stress, such as is imposed upon it by ordinary tensile stress testing machines. Examinations of numerous cases of machine parts, broken under actual working conditions, indicate that at least 80 per cent of these ruptures are caused by fatigue stresses. Most fatigue ruptures are caused by bending stresses, and frequently by a revolving bending stress. Hence, to test materials for this class of stress, the tests should be made to stress the material in a manner similar to that in which it will be stressed under actual working conditions. This can be accomplished by subjecting a projecting test piece held at one end to a load at the other end, and revolving the test piece while subjected to the load. Machines have been developed for carrying out tests of this kind.

STEEL CONTAINING COPPER

Tests made by a committee of the American Society for Testing Materials with the cooperation of the United States Bureau of Standards, together with other data available, prove that by alloying from 0.15 to 0.25 per cent copper with normal open-hearth or Bessemer steel, the rate of corrosion of steel is very much reduced, where the products are exposed to alternate attacks of air and moisture. Two heats of basic open-hearth steel were copperized in varying amounts from about 0.01 per cent up to 0.25 per cent. Sheets from different ingots were made and exposed to the weather for various lengths of time. The tests proved that very low amounts of copper in steel tend to lower the corrosion rate. Copper, to the extent of 0.12 per cent, is said to be sufficient to neutralize the influence of sulphur amounting to 0.055 per cent. Copper amounting to 0.15 per cent is sufficient to protect steels even if the sulphur content is much higher than normal.

ADHESION AND FRICTION

Friction should not be confused with "adhesion," which not only resists the motion of one body upon another, but tends to hold the two together so that they cannot be separated. Adhesion is independent of the pressure between the bodies, while friction increases with the pressure. Moreover, the smoother the rubbing surfaces the greater is the adhesion but the less is the friction; two perfectly smooth surfaces, if such were possible, would be frictionless, while the adhesion between them would be very great, as in the case of precision gage-blocks. Lubricants increase the adhesion and diminish the friction. When the pressure between two bodies is small, the adhesion forms a considerable part of the resistance, and, as the pressure increases, it becomes proportionately less, since adhesion does not increase with the pressure. At ordinary pressures, the effect of adhesion can generally be neglected, and the whole resistance considered as friction. The coefficient of friction of solid rubber tires on cement and vitrified brick roads is about 0.6, while that of pneumatic tires under similar conditions is 0.5. The coefficient of adhesion is greater than that of friction, and incidentally this partly explains why an automobile stops more rapidly when the wheels are kept moving than when they are locked; hence the increased danger when a car skids if the rear wheels are locked by the brakes.

SCALE PREVENTION IN BOILERS

A great many substances are introduced into boilers with the object of preventing the scale from forming into a hard mass. Among these may be mentioned kerosene oil and petroleum. The former is generally considered preferable. There are also anti-incrustation compounds on the market, although, in general, they should be used with caution, because many of them will affect the life of the boiler. It is claimed by those who have used kerosene that one quart per day for each 100 horsepower is sufficient to prevent the formation of scale, even though the water is very hard and impure. Kerosene is also effective for breaking up and loosening hard scale after it has formed. The most certain and effective remedy for the removal of scale which has been deposited on a boiler is by mechanical means, although chipping and scraping off the scale is often difficult and sometimes impossible, owing to the lack of room. The best method is to prevent the formation of the hard scale, and the easiest way of removing impurities is by opening the blow-off valve occasionally. A large part of the scale is naturally carried to the coolest part of the boiler (to the mud drum, if there is one), and it may be removed by blowing off the boiler while under steam pressure. The fact that many impurities are held in suspension and float as a scum on the water for some time before settling, has led to the use of the surface blow-out apparatus.

BABBITT METAL FOR HEAVY PRESSURES

The composition that follows gives a rather hard babbitt metal which may be used for lining connecting-rod and shaft bearings subjected to heavy pressures. This composition conforms to the S. A. E. standard specification for No. 11 babbitt, and is suitable for die-castings.

Cast Products: Tin, minimum, 86 per cent; copper, 5 to 6.5 per cent; antimony, 6 to 7.5 per cent; lead, maximum, 0.35 per cent; iron, maximum, 0.08 per cent; arsenic, maximum, 0.10 per cent; bismuth, maximum, 0.08 per cent; zinc and aluminum, none.

Ingots: Tin, minimum, 87.25 per cent; copper, 5.5 to 6 per cent; antimony, 6.5 to 7 per cent; lead, maximum, 0.35 per cent; iron, maximum, 0.08 per cent; arsenic, maximum, 0.10 per cent; bismuth, maximum, 0.08 per cent; zinc and aluminum, none.

RELAYS IN ELECTRICAL WORK

A relay is an electrically operated device used in connection with the automatic tripping of circuit-breakers or oil switches when predetermined abnormal conditions occur. Oil switches and air-break circuit-breakers that are tripped automatically are provided with alternating- or direct-current trip coils to which the contacts of the relays may be electrically connected, or with tripping mechanisms on which the movable part of the relay may act directly. The usual purpose of a relay is to assist in disconnecting that part of an electrical system in which a fault has occurred, from the rest of the system, with the least practicable delay; and to limit such disconnecting to that part of the system that is in trouble. Relays, however, are used for other purposes, such as for signaling; for controlling the operating current of solenoids, motors, etc., and thus reducing the amount of current to be broken by the control switch and the size of leads run to the switchboard; for bell alarm or lamp indication of the automatic operation of oil switches or circuit-breakers; and for electrically interlocking switches or circuit-breakers. Relays are divided into two general classes: Direct-current relays and alternating-current relays.

What Our Readers Think

on Subjects of General Interest in the Mechanical Field

MORE GRADUATED SCALES ON LATHES

Practically every engine lathe is made with a tailstock that can be offset to provide for taper turning, but very few lathes are equipped with means for indicating accurately the amount of offset. The writer believes, however, that a dial should be placed on one of the offset adjusting screws. If the dial has 100 divisions and a 10-pitch adjusting screw is used, the graduations will each represent an offset of 0.001 inch. If the dial is made about 1 1/4 inch in diameter the graduations will be easy to read. A device of this kind or of a similar nature, if well made, should prove of value to the man who has to turn tapered work. Such a refinement would add but very little to the cost of the lathe and would be appreciated by many shop men.

A few manufacturers graduate the tailstock spindles of their lathes and it seems to the writer that this is a feature that all makers should adopt. The graduating of the tailstock spindle adds but little to the cost, but greatly facilitates the work of drilling holes to an exact depth.

It would also be convenient to have a scale on the lathe bed between the two front vees. A movable pointer could be attached to the carriage which could be adjusted through a distance of one inch by means of a thumb-screw, thus making it possible to set the pointer on an inch mark regardless of the position of the carriage. Such a scale would prove especially useful in machining irregular shaped pieces which are difficult to measure with an ordinary scale. Measurements could also be taken while the work is in motion. No lathe builder would think of building a lathe without a dial on the cross-feed screw, and it would seem to the writer that there is no reason why a scale or dial should not be provided for the longitudinal feed as well.

Charles W. Walker

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REVERSE PROCESSES IN CHECKING DESIGNS

Soon after the installation and preliminary trials of the first of a number of special machines made according to the designs of the user, it became necessary to remove the friction clutches that controlled the spindle speeds. It was then discovered that these rather complex and rapidly wearing elements could not be disassembled without first removing the spindle and then tearing down the whole headstock.

Evidently the design had been worked out from the base upward. The gear sets for the spindle driving and feeding mechanisms had been compactly grouped underneath the spindle and its bearings. The spindle, which was of unusually large diameter, shut off access to the small parts underneath. Probably the builder did not notice the disadvantages of this construction, because the most natural way to assemble the machine was from the base up.

Attention having been called to the difficulty in removing the clutches, the accessibility of other parts subject to wear was investigated. It was then revealed that not more than half of the parts could be replaced except by disassembling large units, which in some cases would require hours instead of minutes as should have been the case. This example shows the importance of having the designers of special machinery mentally disassemble the machines they design in order to determine if the parts subject to wear can be readily replaced without disturbing other members.

In following through this reversal of the developing processes, it is well to remember that even though parts can be easily assembled it does not necessarily follow that they can be easily removed under conditions that often develop in service. There are two distinct reasons for this, and each should be given careful consideration. The first is that while distinctive elements of a design may be made up of a few or many units, there are usually only a few of the total number of parts that must be replaced as a result of wear or breakage. In such cases it is not only essential that the element itself be accessible, but that those parts most likely to give trouble be so arranged that they can be removed without disturbing the remaining parts of the unit. The second reason is that units that can be readily taken apart when new cannot always be disassembled when badly worn. The far-sighted designer will therefore study the effects of wear upon every pair of contacting members, and make provision against their being locked together as a result of the action of one part on the other.

It should be remembered that clearances are usually less than those specified on the drawings. This is particularly true of special machinery, which is usually built from castings made from patterns intended for the production of only a few molds. Generally no particular care is taken to trim such patterns to the thicknesses specified. Besides the clearance necessary for the removal of a part, additional clearance is often required for the tool or other means by which it is to be removed. On the particular machine referred to at the beginning of this article there was one oversight in this respect.

The process of reverse design or mentally disassembling a machine, calls for a careful analysis and segregation of those elements that appear to be most likely to be affected by wear, but much embarrassment and criticism will be spared the designer who makes a practice of subjecting all his designs to this process before allowing them to leave his hands.

P. H. Bryant

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EXTRAVAGANT USE OF HIGH-SPEED STEEL

I read with a great deal of interest the article entitled "Extravagant Use of High-speed Steel" which appeared on page 130 of October Machinery. It is my belief that we can get along just as well if we use less high-speed steel. I have often been in plants where tools made entirely from high-speed steel and weighing as much as 20 pounds were being used in large planers. Obviously this is not an economical practice. In most of these cases the tools would have given better results if the shanks had been made from carbon steel with inserted blades or cutters of high-speed steel.

If the carbon steel shank is hardened and drawn, it will possess a desirable springy quality which is lacking in the tool made entirely from high-speed steel. The shank of carbon steel will then simply spring or bend under stresses that may cause the high-speed steel shank to break. Most toolmakers and forgers, however, seem to be ignorant of the fact that the average piece of forged and hardened high-speed steel lacks this springy quality.

Often when a tool fails, the production department will send a sketch of the tool or the broken tool itself to the tool department with a requisition for another one like the sample or like the one shown in the sketch. The tool department naturally follows instructions, and the new tool, being exactly like the old one, more than likely fails within a short time. When a tool breaks or fails to give the desired results, the cause of the failure should at least be considered and eliminated if possible when making the new tool.

F. Rattek

Machine Forging and Bending Dies

Design and Use of the Forging Type of Die for Bending Operations

By C. C. HERMANN

THE bending of iron and steel is essentially a forging operation. The piece that is bent undergoes certain physical changes, which, in some instances may materially affect the strength of the article. For instance, if the straight bar shown at *A*, Fig. 2, is bent to the shape indicated at *B* a physical change takes place in the structure of the fibers in the bent portion. Some of the fibers are elongated, others remain as they are in the original bar, and still others are shortened or doubled back upon themselves. Thus we have a tension, neutral, and compression zone in the bar at the bend and during the bending operation. Obviously, the greater the dimension *C*, the greater will be the stretch and the compression of the fibers of the steel. On bars of very small diameter, where the elongation of the fibers does not exceed their elastic limit, it is not always necessary to use heat to obtain a satisfactory bend. Whether or not heat must be applied depends largely upon the nature of the steel. For instance, annealed iron and steel may be bent cold easier than the higher carbon steels, such as spring steel.

Making Right-angle Bends

Referring again to Fig. 2, suppose we have a bending die provided with two bending faces located exactly at right angles to each other and that we desire to bend the piece to exactly a right angle. After the piece has been bent and the dies separated we find that the piece has sprung back so that the included angle is greater than a right angle. This is due to the elasticity of the steel, and in order to obtain an exact right-angle bend in the piece it must be bent slightly beyond the right-angle position in the die. In other words, the die faces must be designed with an included angle slightly less than a right angle.

The degree to which steel must be bent past the desired angular position depends upon the characteristics and the dimensions of the steel. Annealed open-hearth steel does not spring back as much as spring steel or old rail carbon and other steels that vary in their carbon content. The amount of spring-back also depends upon whether the piece is bent while hot or cold. Hot bends spring back less than cold bends. As an example, soft annealed flat steel, 1/4 to 3/8 inch thick, bent cold, will spring back 1 or 2 degrees; whereas flat steel of the same size having a carbon content ranging from 0.40 to 0.50 per cent, will spring back 3 or 4 degrees, and if the material is annealed open-hearth spring steel, the spring-back will be from 10 to 15 degrees. Hot bending reduces the spring-back of mild steel to from 1/2 to 1 degree. Spring steel, when bent hot, will spring back slightly during the cooling operation, unless held in a form and quenched to a dull red.

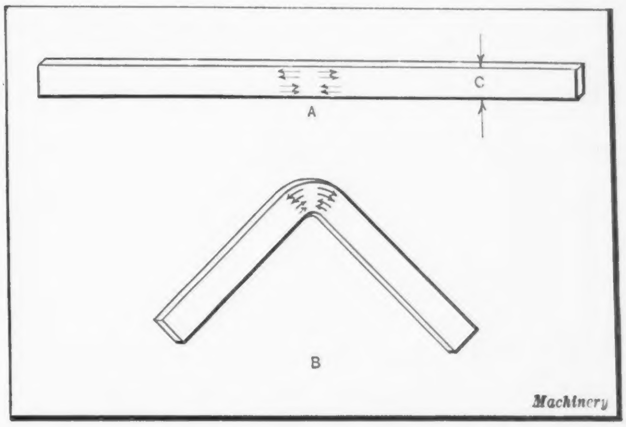


Fig. 2. Diagram showing how Bending acts on Fibers

Heating the Work Ready for Bending

The degree to which the steel is heated determines to a considerable extent the final strength of the bent piece, as well as the amount of spring-back. First of all, the piece must be heated exactly at the point where the bend is to be made, and as little each side of this point as possible. To heat the piece beyond the bend, is not only a waste of heat, but it causes excessive scaling of the steel and often results in kinks developing in the work. In the case of long pieces, it is not practical to design dies that will cover the entire length of the steel. When the dies come together on a long piece, there may be sufficient "whip" in the steel to cause a kink at the edge of the die.

The accuracy of the finished piece depends to a considerable extent upon the heating of the stock. The stock will draw more where a comparatively high heat exists, and for this reason the center of the heat must be located as nearly as possible at the exact point of the bend. For example, attention is directed to the piece shown at *D*, Fig. 1, which is a wheel-spindle made of stock 1 9/16 inches in diameter, bent to a right angle, the bend coming in the center of the stock.

The dies designed for bending this piece are also shown in Fig. 1. The base block is shown at *A* and the ram block at *B*. The dies are designed for use on the bulldozer. The working faces of both blocks are provided with half-round recesses to accom-

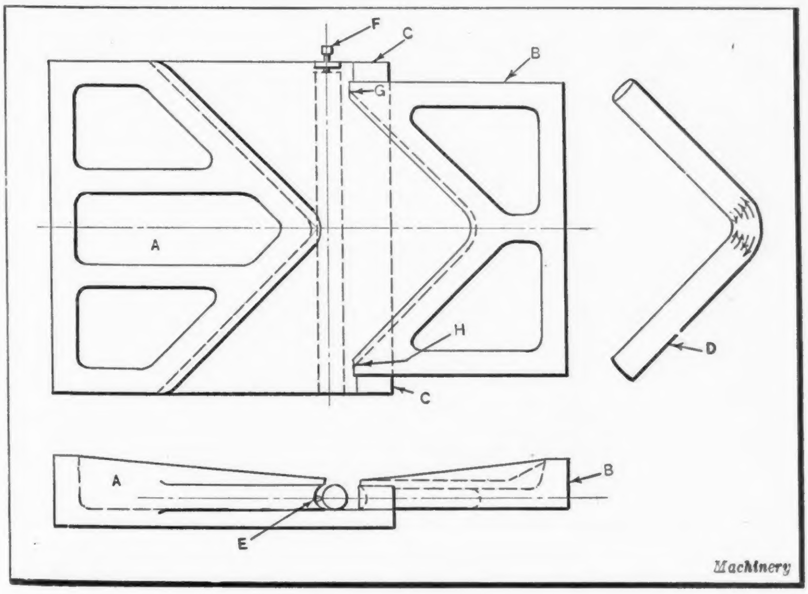


Fig. 1. Die for making Right-angle Bend

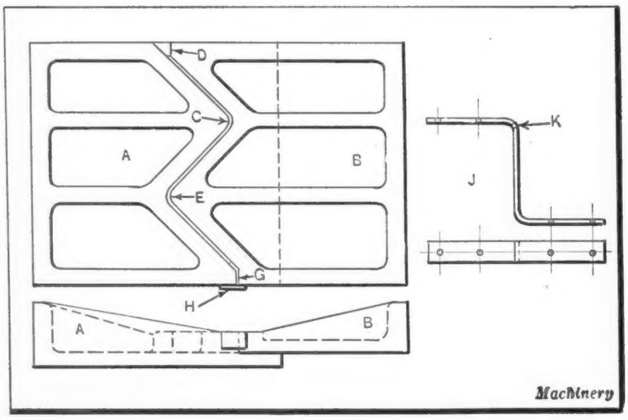


Fig. 3. Bending Die for Z-shaped Piece

modate the stock. The base block is provided with guides *C*, between which the ram block slides on the forward stroke of the ram. These guides serve to center the ram block and prevent any side bind of the dies being transmitted to the ways of the machine.

The base block is provided with a pointed pin at *E*, which makes a depression in the center of the stock when the ram forces it into the groove, thus preventing end movement of the piece or unequal drawing while bending. The piece is centered on the die by the adjustable stop-pin *F*. This stop is made adjustable to provide means for compensating for any draw from one side or the other of the stock that cannot be entirely prevented by the centering pin. An uneven draw is also experienced when the heat is greater on one end of the work than on the other. When the center of the heat is to one side, the ram die causes greater elongation of the stock on that side which results in a piece of work having legs of unequal length. Expansion and contraction must also be taken into consideration when the heat is uneven, and the stop *F* adjusted to suit.

The stock is heated to a full red color and laid upon the die with the far end against the stop as indicated by the dotted lines. The ram then comes forward into contact with the piece at the points *G* and *H*. As the ram proceeds further in its travel, the ends of the work are bent across the center point of the base block until, at the end of the stroke, the work is pressed tightly into the groove of the dies for its full length. The ram then recedes, and the work is pushed back with the tongs and removed.

Preventing End Movement of the Work

It is desirable in all cases where any degree of accuracy is required in the finished piece to provide some means for positively holding the work against end movement while bending. Instead of using a pointed centering pin like the one shown at *E*, Fig. 1, a hole is sometimes drilled or punched in the work to fit a locating pin in the stationary block. Still another method is to hold the stock against movement with a clamp while the dies are in operation. To depend upon the balancing of the ordinary stresses to center the work is generally unsatisfactory, but in some cases this means must be resorted to. The piece of work shown at *J*, Fig. 3, illustrates a case of this kind.

In the illustration, *A* is the base block and *B* the ram block. The piece is a flat bar, 1/2 inch thick and 1 1/2 inches wide, and is to be bent to a Z shape. The work is laid across the die with one end *G* against the end stop *H* and one side against the point *C* of the base block. The stock is held in the tongs until the points *D* and *E* of the ram come in contact with it.

A hole is punched in the stock at the point *K*, and a corresponding pin driven into a hole in the base block at *C* over which the work is placed. This pin prevents end movement of the work. An objection to the pin in this case is that the stock is likely to be drawn excessively in the section between *C* and *E*. However, this depends upon the heat of the stock at this point, since its ductility may be such that its resistance to stretching will cause the stock to draw around the point *E* of the ram block. Experimenting with the die is the only way to determine how the stock will act under these conditions. The heat may be regulated so that the draw will be entirely from the far end until just before being gripped between the blocks, when further advance of the ram will cause elongation between points *C* and *E*. The length of this section will invariably be less than the length of the corresponding part of the die when the stock has cooled, due to contraction, and this must be taken into consideration in the design of the die.

Bending Die Equipped with Work-holding Clamp

The placing of a hole *K* in the bend of the piece is often objectionable, because it weakens that section of the piece. To overcome this objection, the die may be designed as shown in Fig. 4, and provided with a clamping device. In this illustration the base block is shown at *A*, the ram block at *B*, the stock at *C*, and the clamping device at *D*. The work is placed over the pins *E*, which are secured in the base block and spaced to suit the punching of the piece, as shown in the plan view of Fig. 3. The straight piece projects to the right, as shown by the dotted lines in Fig. 4, extending past the ram block when the ram is in its rear position.

As the ram comes forward, the portion *F* strikes the work, carrying it forward and bending it around the corner *G* of the base block during the early part of the stroke. The second bend is produced during the latter part of the stroke as the corner *G* of the ram block advances toward the face of the base block. The clamp *D* consists of an eccentric block *H* pivoted on a pin located in the end of handle *J*. The pivot pin is secured to the base block, so that when the work is placed over the pins *E* and the clamp swung around, the work is securely clamped against the base block and cannot move under the prying motion of the ram block as it swings the projecting portion of the work backward. There is a tendency for the stock to bow slightly between the heel of the ram block at *K* and the clamp *D*, but this can be remedied by restricting the heated section to the point *L* where the bend is made.

The die shown in Fig. 4 has the advantage over that shown in Fig. 3 in that more accurate work will result, due to the clamping of the work over the pins, and there will be less drawing of the stock between the bends. The likelihood of the piece becoming weak between the bends is therefore lessened. The weakening of the piece due to the punching of the hole in the bend at *K*, Fig. 3, is also eliminated. With the die shown in Fig. 4, the stock for the straight section between the bends is drawn around the corner *G* of the ram block, and the stock is stretched only a slight amount at the end of the stroke.

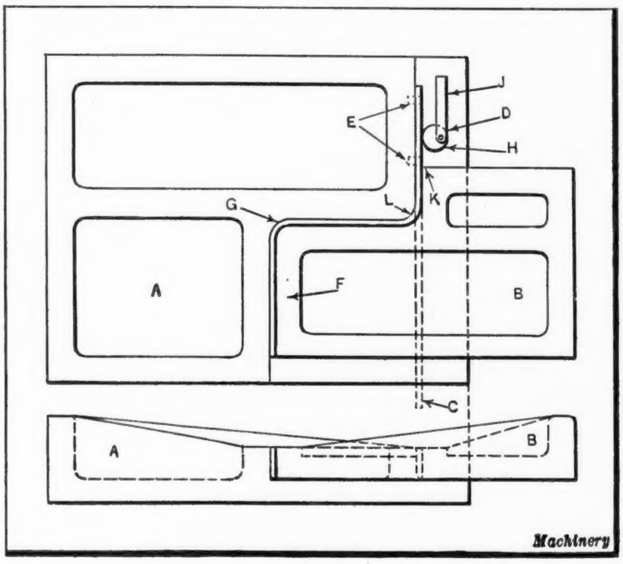


Fig. 4. Die equipped with Work-holding Clamp

Dies for Bending Plow Bail

At *A*, Fig. 5, is shown a plow bail, which is bent to shape on the bulldozer die shown at *E*. The stock is open-hearth 0.10 to 0.15 per cent carbon steel, 1 5/16 inches in diameter. At *D* the die is shown open and with the stock *a* in position for bending. The base block is shown at *b*, the ram block at *c*, the bending wings at *d*, and the locating stop at *e*. The base block *b* is ribbed, as indicated, to support the bending faces, and is provided with a plane surface *f* which extends beneath the ram block when the die is closed. The wings *d* are pivoted at the points *g* on the base block, and are provided with a smooth surface at *h* along which the ram cams *i* must slide in order to close the wings against the stock, thus producing the bend without drawing the stock.

The corners *j* of the base block are rounded to facilitate the bending of the lower legs *k* of the piece *A*. It will be noticed that as the ends of the work are thrown around by the wings of the die the extreme ends will strike the base block on the rounded corners *j*. The corner *l* of the wings *d* must then produce the right-angle bend, as shown at *m* in view *E*. Therefore, the work must be drawn around corner *j* of the base block, and by making this rounded and smooth, there will be less abrasion of the work at this point. The corners at *n* and *p*, view *A*, are bent to a radius of 2 inches, and the die is given a corresponding radius at the corners *m* and *r*.

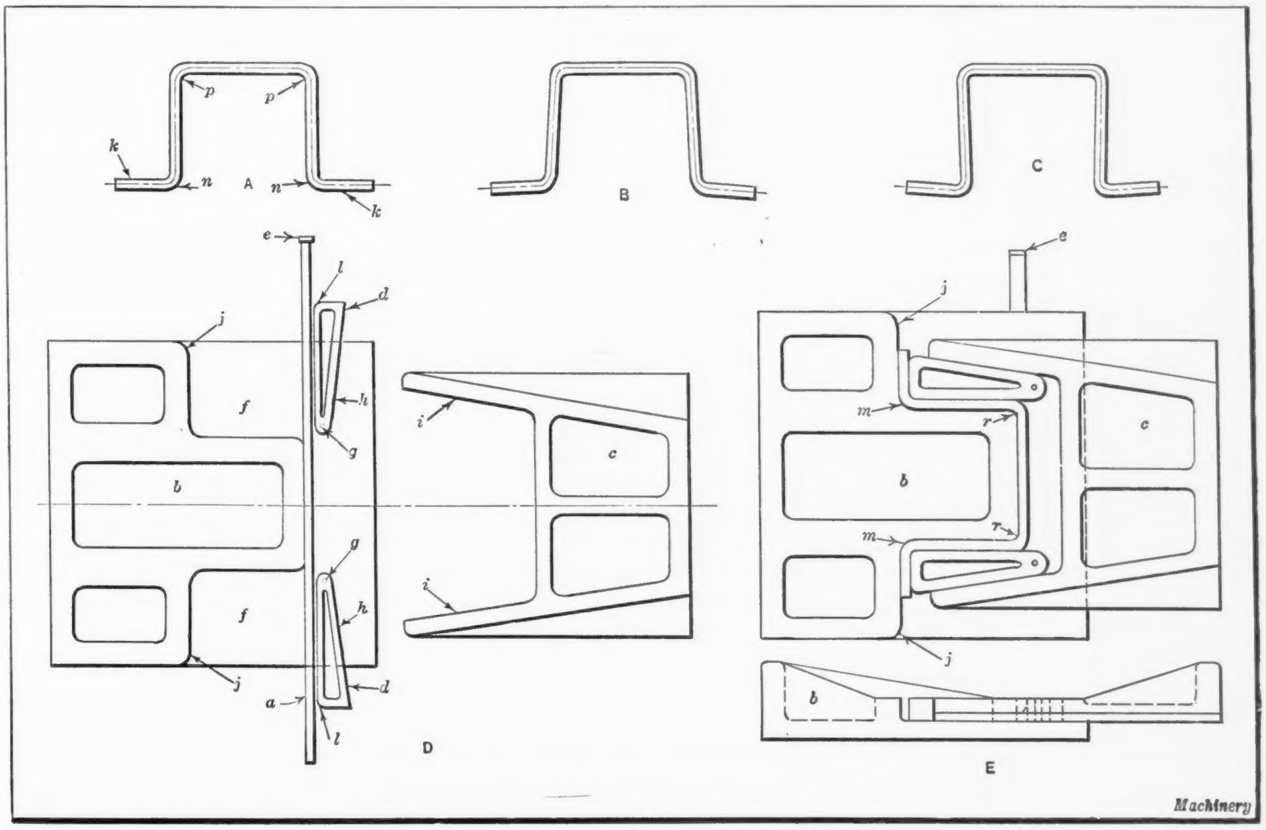


Fig. 5. Bending Die for Plow Bail, shown in Open and Closed Positions

As pointed out in a previous paragraph, the elasticity characteristic of the steel causes it to spring back somewhat after bending. If the dies were designed with the bending faces at right angles, the finished piece would appear somewhat as shown in view *B*. In order to obtain work that will have the desired right-angle bends, the die must be designed so that the bends will be less than a right angle. The piece, when held in the closed die, will therefore look like that shown in the exaggerated view at *C*, and when released and cooled, it will appear as at *A*.

Calculating Heat Requirements

The work should be heated to a full red color in order to avoid rupture of the fibers at the bends, and to produce uniform results, the heat must be even. Much depends upon the experience of the operator in hot bending, as any considerable variation in the heats will cause variations in the bends. While the construction of furnaces to accommodate various classes of work that is to be bent hot will be dealt with in a future article, a brief description of the equipment for heating the piece of work shown at *A*, Fig. 5, will be given here. It is best to use an oil-heating forge for work of this kind that must be bent in several places. Obviously, there must be four points of maximum temperature corresponding to the positions of the four bends. With a coke forge, it would be necessary to heat the entire length, in which case the point of highest temperature would be at the center of the piece where no bending or other operation is performed. In that case, there would be considerable waste heat in producing the piece.

Referring to the upper view in Fig. 6, the points where the heat is desired are at *A*, *B*, *C*, and *D*. The heat should extend three or four inches each side of all these points. Figuring a twenty-five per cent run back, the length of the directly exposed metal need be only four inches for each heated section. The weight of each heated section is therefore 2.3 pounds, making the total weight of the heated areas per bar equal to 9.2 pounds. Taking the specific heat of steel at 0.11, the rise in temperature to 1750 degrees will result in the absorption of 1771 B.T.U's per bar. As the production will be close to fifty pieces per hour, the hourly heat requirement for the stock alone will require the expenditure of 88,550 B.T.U's. The heat required to raise the temperature of the furnace will be close to 50,000 B.T.U's accompanied with a radiation loss for this size of furnace of close to 40,000 B.T.U's per hour. The heat carried away by the flue gases will run close to 500,000 B.T.U's per hour, making a total heat requirement of 628,550 B.T.U's per hour after the furnace has been heated to the proper temperature.

The total heat content of one pound of fuel oil is, in round figures, 19,000 B.T.U's. Therefore the oil consumption will be 33 pounds per hour or 4.4 gallons of fuel oil per hour. Dividing this by 4, since there are four heating points, we find that each heat will require a burner capa-

city of approximately 1.1 gallons per hour. The burners are preferably placed in the ends of the furnace, the cross-section of which appears as seen in the lower view, Fig. 6. The work is shown at *E*, and the oil burners are at *F*, located somewhat below the work, each burner being provided with a separate combustion chamber as indicated at *G*, *H*, *J*, and *K*. A vertical recess is also provided above each chamber as at *L*, *M*, *N*, and *O*. These spaces are ventilated above by leaving a brick out of the arch at intervals, thus forming flues which extend to the atmosphere above the furnace. The gases liberated by the flues are carried outside of the building by a hood covering the top of the furnace and connecting with a pipe leading to the outside. The furnace is built in a structural iron framework and supported from the floor by properly designed legs.

In order to make the handling of the parts as easy as possible, the heating chamber of the furnace should be about thirty-six inches from the floor. High-temperature firebrick is used in the furnace as a refractory lining, and an insulating brick wall is desirable to reduce the radiation losses to a minimum. Common brick may then be used as the first course in the bottom of the furnace. The details of the furnace design are not gone into here, the intention being merely to give an idea of the heating problem presented by piece *A*, Fig. 5.

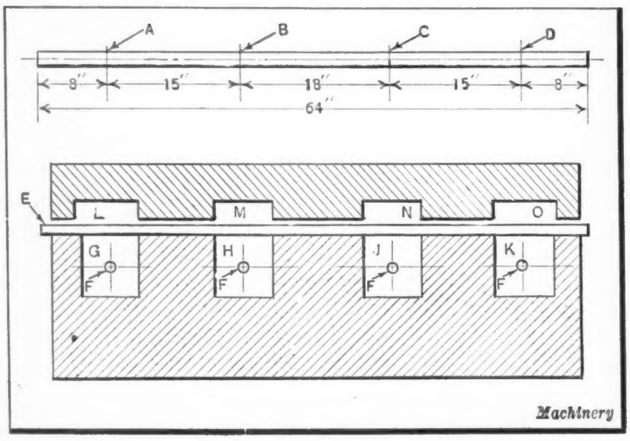


Fig. 6. Cross-section of Heating Furnace for Piece shown at A, Fig. 5

* * *

AUTOMATIC MILLING OPERATIONS

There are four milling operations performed on small pieces of cylindrical machine-steel stock in producing binder chain links of the design illustrated at a considerably enlarged scale in Fig. 1. On each of these operations the production averages 23 pieces per minute. The blank pieces are 5/16 inch in diameter and about 1/2 inch long. The four operations are carried out on a Cincinnati 24-inch automatic milling machine provided with the equipment shown in Fig. 2. There is a four-station indexing base *F*, four interchangeable work-holding plates *G*, which are applied to the indexing base to suit the different operations, and four arbors *H* loaded with the necessary cutters. When mounted in place, the arbors are driven at the left-hand end and supported in a bearing at the right-hand end.

The machine is shown set-up for the first operation, which consists of milling slot *A*, Fig. 1, in ten pieces held along one side of the work-holding plate *G*, Fig. 2. The ten pieces are milled simultaneously by means of the circular saws mounted on arbor *H*. Slot *A* is about 0.100 inch wide and 3/16 inch deep. Each piece is seated in a bushing in plate *G*, and as the pieces approach the cutters they are clamped securely in the bushings by fingers that project toward the work-holding plate on each side of every cutter. These fingers are backed up by springs. With the exception of loading, the operation is entirely automatic, the work-holding plate being fed to the cutters, returned, and indexed 90 degrees during the return, after which the cycle is continued. At the return stroke the pieces of work just machined are automatically ejected by a mechanism that pushes them into a trough from which they slide into a pan. The work-holder indexes from left to right.

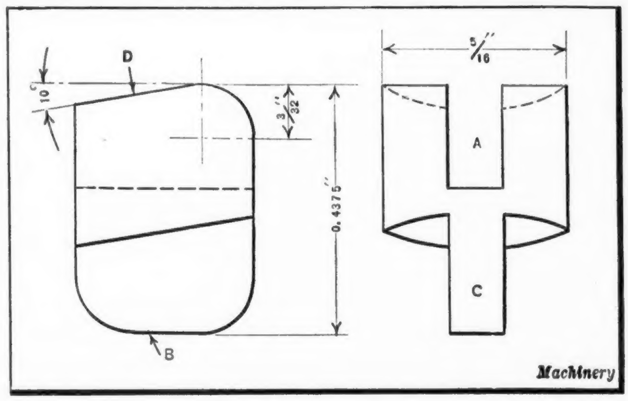


Fig. 1. Chain Link milled from Cylindrical Blanks in Four Operations

In the second operation, end *B*, Fig. 1, is form-milled at right angles to slot *A*, by substituting the proper work-holding plate on base *F*, Fig. 2, and mounting arbor *J* in the machine. The third operation consists of milling tang *C*. For this work arbor *K* and the corresponding work-holding plate are employed. In the fourth operation end *D* is form-milled by using arbor *L* and the corresponding work-holding plate. In each operation, the cutters are revolved at a speed of 104 revolutions per minute and fed at the rate of 3 1/4 inches per minute. The form-milling cutters are 2 3/4 inches in diameter, and the others 3 1/2 inches in diameter.

* * *

The twenty-second annual Handbook of Automobiles, which has just been issued by the National Automobile Chamber of Commerce, illustrates 193 motor vehicles, of which 116 are passenger cars, 62 commercial cars and motor trucks, 6 taxicabs, and 9 motor buses, which will be produced this year by the manufacturers who are members of the Chamber. With the exception of five electric vehicles, all the cars are gasoline propelled. In all, 795 different models are listed.

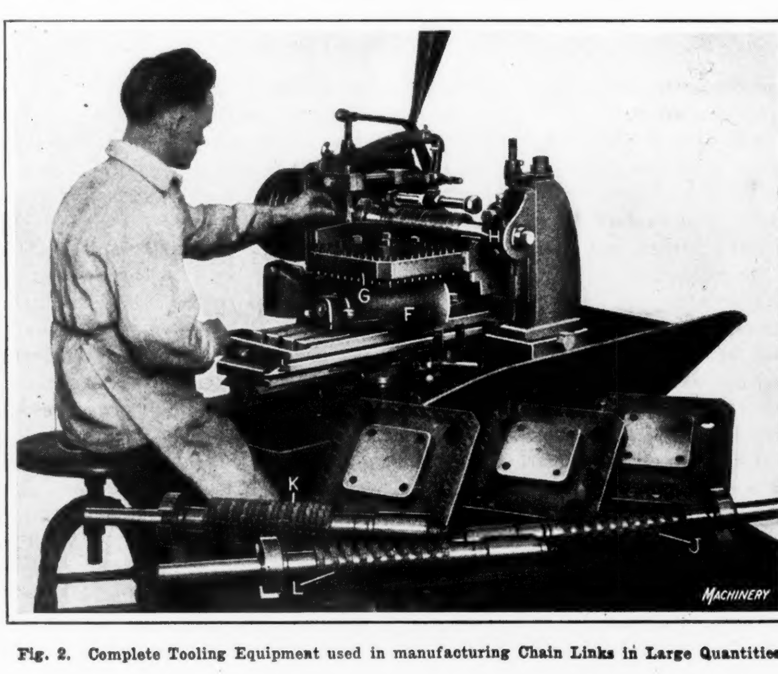


Fig. 2. Complete Tooling Equipment used in manufacturing Chain Links in Large Quantities

Design of Automatic Packing Machinery

By ALBERT A. DOWD

IN the numerous examples given in preceding articles on this subject, we have noted how the shape of a piece to be packed influences the method of feeding. Attention has also been called to the fact that the method of selection or separation of the pieces depends very largely upon this final arrangement or grouping. Pieces of identical size and shape, for instance, might be handled by entirely different methods if the final grouping of the pieces was to be dissimilar.

For example, the tablet shown at *A* in Fig. 1 might be packed as at *B* with a number of pieces in a row wrapped in such a way as to make them up in the form of a roll; as at *C* in two rows on edge in a box; as at *D* with two layers flatwise in a box; as at *E* with a number of layers and a cardboard spacer between each; or loosely in a bottle as at *F*. The same thing applies to so many products that it is obviously impossible to enumerate them all. So far it has been the writer's endeavor to deal with fundamental points in design, although it has been necessary in some instances to go into detail to some extent. No matter how much information may be given with regard to magazines, hoppers, selectors, and feeding devices, the very next problem encountered by the designer might differ radically from any that have been described and therefore require special treatment.

When the manufacturer of a certain product decides to wrap or pack it automatically, he is often insistent on keeping the package in a certain form, because it is known both to the trade and to the consumer. From a selling point of view this is a very important matter, and yet when packing the piece automatically many problems may be encountered that could be greatly simplified by using some other form of package. A certain shaped bottle is perhaps a characteristic receptacle for a given product, or a box of unusual shape for another. It is generally unwise to attempt to convince any manufacturer that he should change such things even if the mechanical problems involved could be greatly simplified by so doing. Occasionally it is possible to preserve the outward form and at the same time simplify the wrapping or packing. The writer has known of cases where an important job was taken away from one engineering firm and given to another, just because the designing engineer of the first company tried to convince the manufacturer that he should change the form of package which had already been on the market for some years. This point is continually coming up in automatic machine design and the designer will do well to remember the customer's viewpoint and be guided by his wishes.

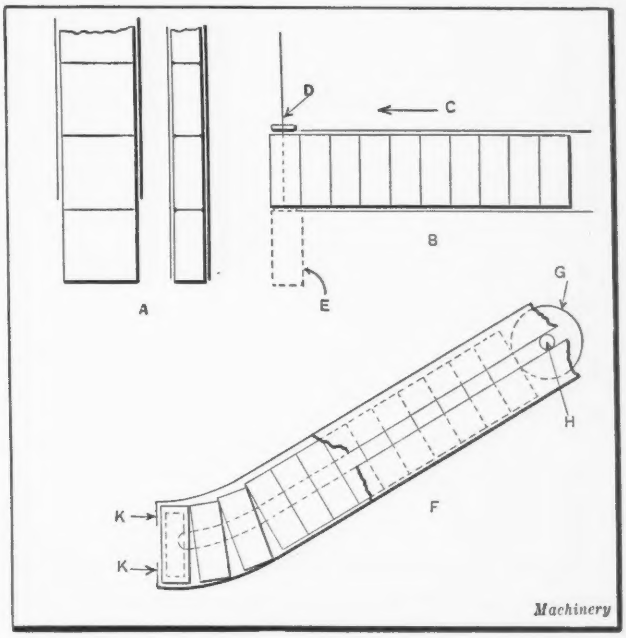


Fig. 2. Diagrams illustrating Difficulties met with in feeding Boxes on Edge

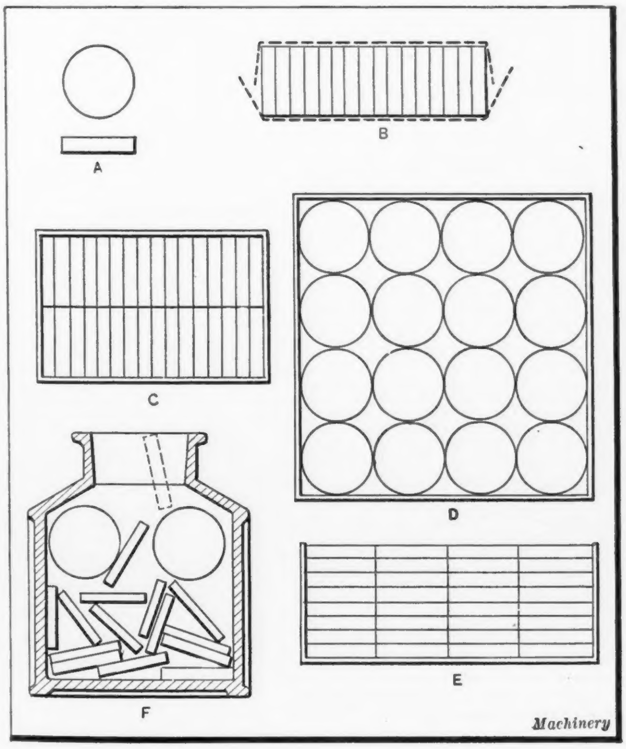


Fig. 1. Diagrams showing Various Methods of packing the Same Piece

Preliminary Considerations in Designing Device for Packing Cylindrical Rolls

Fig. 3 shows six cylindrical pieces *A* which are to be packed in the box shown at *B* with the ends protruding slightly as indicated. A cover is to be slipped on the box and the package sealed by hand. Information gained from previous descriptions of methods used in handling cylindrical pieces should make it a simple matter to solve the problem of bringing the pieces down through a chute as shown at *C*. First the pieces must be arranged so that they will be in line one over the other. The box is then placed in a suitable position and the pieces pushed into it, or the box is dropped over the pieces. Several ways of handling this problem are possible and should all be considered before starting work. By taking several units and placing them against a straight edge, it will be evident that they can be easily held together and fed into the box without difficulty.

Now would it be best to lay the pieces down flat or could they be fed and arranged more easily if placed one over the other? There is not a great deal of difference, but if arranged vertically, a gravity feed could be used successfully which would be some advantage. The next questions to consider are: How can the boxes be arranged so that they also can be fed in the position desired? Can gravity be depended on for this feed in handling a light cardboard box, or must a mechanical feed be used? This preliminary analysis is well worth while, as it shows the designer, by

comparison, just what problems he is called upon to solve. The average man spends, at the very least, several days in making preliminary sketches, and generally at the end of this time he has a number of ideas. Much of this time can often be saved by settling some of these points early in the process, and while each piece to be handled is a problem by itself, they must all be considered with relation to each other. One piece can perhaps be handled best in a vertical slide, while another may feed better from a horizontal position, but if the two pieces are to be assembled, it may be an advantage to change the method of feeding one in order to simplify the handling of the other.

Problems Encountered in Feeding the Boxes

To continue with the example mentioned, if we have settled on handling the cylindrical pieces one above the other, as shown in the chute *C*, it naturally follows that the box into which they are to be put must be fed on edge. Referring to the diagram at *D*, the six pieces *A* are shown pushed out into the box *B*. The box is placed on spring fingers *E* and *F* which also act as guides to prevent the pieces from catching on the edge of the box when they are pushed forward by the carrier *G*. This carrier has a long movement and is operated by the rods *H*. When the pieces strike the bottom of the box, the carrier movement still continues and pushes the latter off the spring fingers *E* and *F* so that it tips forward and slides down the incline *K*. This, of course, has side guides which keep the box from tipping over to either side. At the bottom of the incline *K* an operator stands and caps each box as it comes through the machine. A conveyor of suitable form can also be used here if desired.

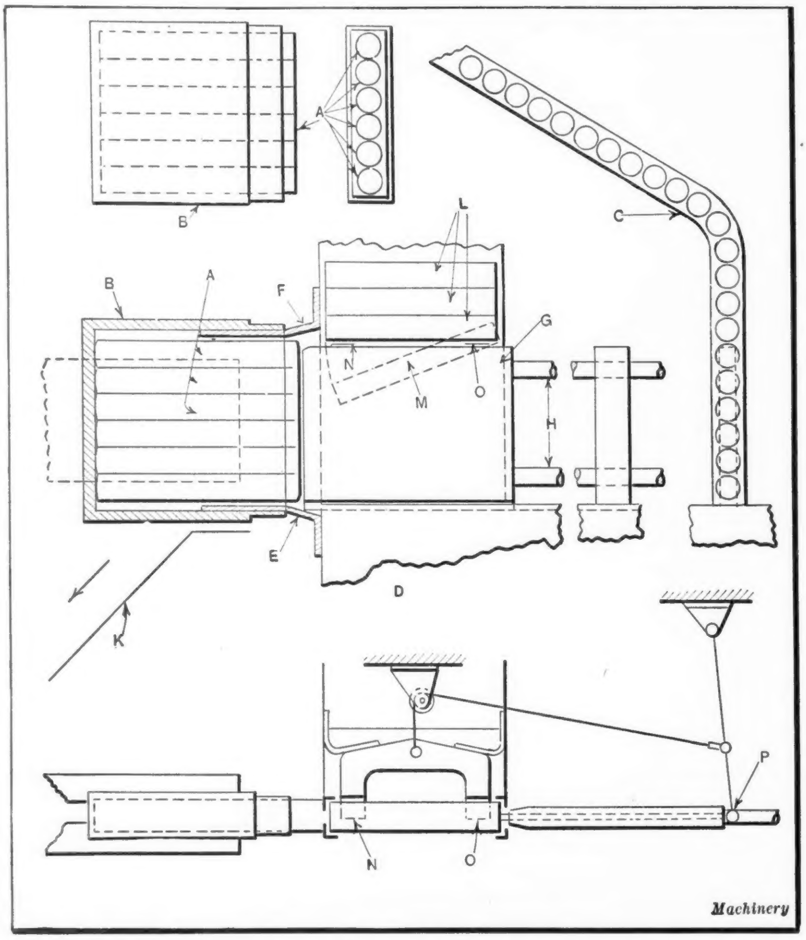


Fig. 3. Feeding Device for Cylindrical Rolls packed in Boxes holding Six Rolls

One of the difficulties encountered in this method of feeding the cylindrical pieces, lay in the fact that a number of pieces lie in the chute as shown at *L*, and when the carrier recedes, after placing pieces in the box, those in the chute would be likely to drop diagonally, as shown at *M*. To prevent such a contingency, a valve having two fingers *N* and *O* was provided. These fingers lie directly under the pieces in the chute and prevent them from falling when the carrier recedes. As the latter approaches the end of its movement, it strikes the lever *P*, which pulls back the fingers *N* and *O* and allows the pieces to drop straight in front of the carrier. The shut-off device can be operated by a simple wire cable over a pulley as shown, or by means of a system of levers.

In feeding the boxes themselves, we have a more difficult problem, for if we attempt to stack these on edge, as shown in the diagram *A*, Fig. 2, a considerable height would be required, and an operator would be kept busy feeding the pieces into the chute. Also if we arrange the pieces in a horizontal chute as at *B*, some form of mechanical feed must be employed to move them in the direction shown by the arrow *C*. In addition it would be necessary to utilize a plunger of some sort, as at *D*, to carry the box out of the magazine to the position shown by the dotted lines at *E*. A mechanical longitudinal feed for pieces on edge is likely to be troublesome, in both the design and operation, for the boxes nearly always tip and get out of position even if a friction feed conveyor is used. A rubber surfaced belt can be employed on certain forms with success, the boxes being carried between side guides. Experiments have shown, however, that more or less trouble is likely to be caused when such a system of feeding is used.

Sometimes a compromise can be effected by using the form illustrated at *F*, in which the pieces lie at an angle, as shown, and are fed downward partly by gravity and partly by the cylindrical weight *G* having an axle *H* supported by a slot in the chute. This weight rolls down behind the pieces and forces them forward so that one box is always against the cowl *K* ready to be forced out into the position required. The axle *H* protrudes far enough so that the operator can grasp the ends with his fingers and remove the weight when putting in a fresh lot of boxes. The disadvantage of this scheme is that it is usually necessary to stop the machine every time the magazine is to be filled, for as soon as the weight is removed, the boxes cease to travel. There are ways of counteracting this trouble by using a friction feeding device which will pick up the last few pieces at the bottom of the chute and keep them moving forward while the magazine is being loaded. The writer has used something of this kind in several cases with success, but it is not generally considered desirable. Ordinarily, it is much better to make any feeding device in such a way that continuous operation is possible, as considerable time is lost in stopping the machine to put in a fresh supply of material.

Continuous Feeding Mechanism

In this particular case, the arrangement finally used is illustrated in Fig. 4. The pieces *A* were stacked in a magazine flat and fed down by gravity until the lower one *B* rested against a steel plate *C*. The magazine was open on the sides at *D* and *E* to a height above the steel plate slightly greater than the thickness of a box. A reciprocating carrier shown at *F* pushes the box forward to position *G*, at which point it overbalances and slides down through the chute, as indicated by the dotted lines, finally coming to rest at the point *H* in the position required. It is easy to pick it up at this point and push it forward over the guide fingers previously mentioned, ready for loading. The carrier *F*,

when it passes under the stack of boxes, takes only the lower one each time, but the weight of the stack rides on top of the carrier which must therefore be very smooth. To reduce friction, the construction may be as shown at *K*, which gives a line bearing at the two points *L* and *M*.

Timing of the Various Mechanisms

An important point in automatic machine design is the timing of the various units. As so many of these have a reciprocating movement, it is evident that the speed of the machine is limited by the rapidity with which these movements can be made without producing undue shocks or vibration. Also it takes an appreciable amount of time for any piece to drop into position in a carrier when operated only by gravity. It is seldom a reciprocating movement can be operated successfully (when picking a piece out of a magazine) at a speed much greater than 90 strokes a minute, unless the movement is very short and almost continuous in its action. For example, in the diagram just referred to, the movement of carrier *F* would normally be controlled by a cam so proportioned that it would move forward and backward rapidly, but would dwell slightly at the end of the return stroke in order to allow the box time enough to drop into position. If operated too rapidly, the latter would drop, but might not "settle," and therefore when the carrier moves forward something might be caught and cause damage. For the reason stated here, many automatic packing machines operate at about the speed mentioned.

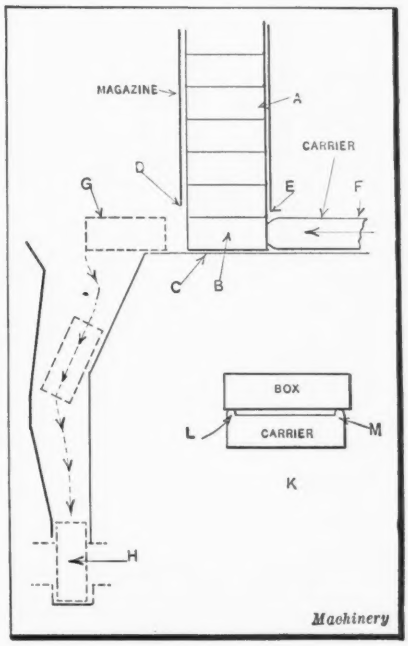


Fig. 4. Method of feeding and turning Box from Flat to Edgewise Position

Station Type Packing Machines

There are two varieties or forms of machines used. One type utilizes various operating units arranged at one given point and operating one after the other (or in unison). The other form is generally termed a station type machine, because of the fact that the work is held on an indexing table and is presented to the various operating units successively as it indexes from one station to another. Fig. 5 illustrates the latter form of machine diagrammatically. A bottle is to be placed on the indexing table *A*, filled with fifty tablets, corked and sealed and finally discharged from the machine. Thirty bottles per minute is the required production on this job.

One of the advantages of the station type machine is clearly shown by this diagram, for it is evident that it would be very difficult to count fifty tablets and place them in a bottle in the short space of time allowed. Unlocking, indexing, and relocking the table uses up one second, leaving only one second for the operation of each of the units. The bottles are drawn from a tray *B* by an indexing carrier *C* and gripped by the spring fingers at *D*. The table indexes to point *E*, where twenty-five tablets are dropped through the chute *F* into the bottle. The same thing is repeated at *G* which gives the necessary amount. At *H* the cork is driven in; at *K* the bottle is sealed; and at *L* it is discharged. It will be seen that by using two filling units the production required is obtained. The station type machine opens up possibilities of this kind and permits more rapid operation.

A careful analysis of any packing problem will usually reveal the limitations of any given unit with regard to speed. The designer should be very conservative in timing up the various units, for although from a production standpoint high speed is desirable, too rapid operation is destructive to the machine. Frequent breakdowns are often caused by high-speed operation, while if the same parts moved more slowly they might function without trouble for years. With reciprocating parts this is particularly noticeable because of the sudden reversal of the movement under high speed.

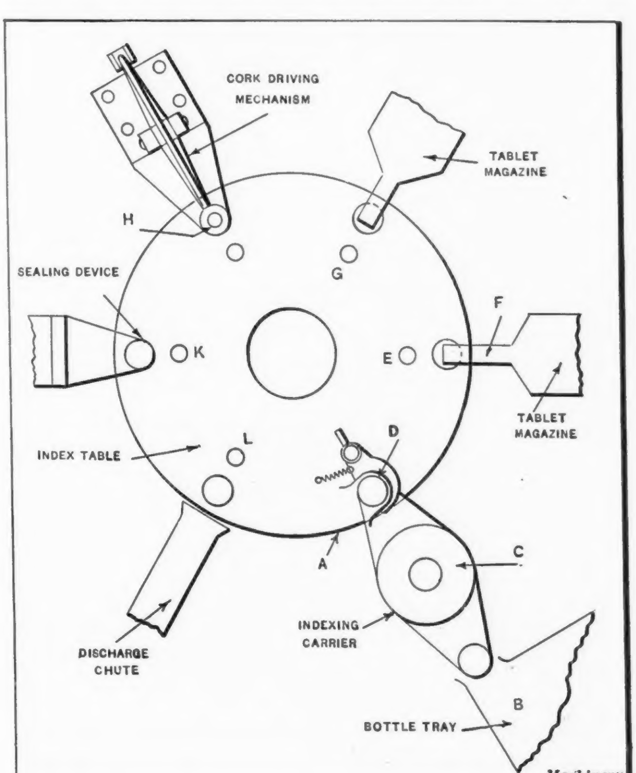


Fig. 5. Diagrammatic Lay-out of Station Type Machine for Bottle-filling and Sealing

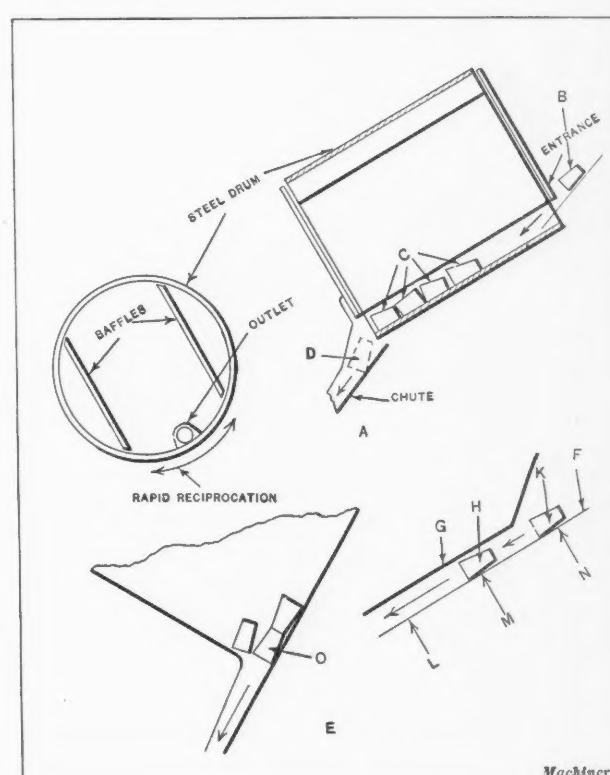


Fig. 6. Two Satisfactory Methods of feeding Corks on Bottle-filling Machines

Cork-feeding Mechanism

In connection with the machine just mentioned, the handling of the cork may be cited as one of the most difficult problems with which the writer has ever come in contact. A cork is very light and has a high coefficient of friction so that it does not slide readily on an incline. Also, unless it is considerably larger at one end than at the other, the difference in weight does not always permit taking advantage of gravity in allowing the pieces to fall into a given position with the large end foremost. The elastic quality of the cork causes it to bounce around in falling down an incline or in a chute so that it is hard to control.

There are two ways of getting the corks lined up from a hopper. One is to allow them to pass slowly into an inclined drum *A*, Fig. 6, so arranged that it reciprocates rapidly. The corks must be spread out in comparatively small quantities on a large plate so that they will enter the drum slowly at *B*. This can be accomplished by making the entrance incline very slight and putting a vibrating device under the plane. Some experimenting is always necessary to prevent the pieces from coming through too rapidly. As they drop into the reciprocating drum they will arrange themselves in a more or less irregular line as shown at *C*, some having the large and others the small end foremost. As the drum reciprocates, the corks strike against the baffles on each side which straighten out any that lie crosswise of the drum. The inclination causes them to pass down and finally out through the opening into the chute at *D*, and although they are not all the same end foremost, they can easily be turned.

Another successful method is to spread the corks out on a gentle incline *F*, as shown in the diagram at *E*, and use a guard plate *G* over the inclined plate so that the corks cannot come through standing on end. They pass down the incline into a neck at point *O* shown in the other view, the opening of which is not large enough to allow more than one piece to pass at a time. It should be a little larger than the large diameter of the cork but still small enough so that two cannot become wedged if they both happen to come down small end foremost.

An important point in connection with this method of handling is in the vibration of the plate. A vibrator placed at a single point will seldom be found satisfactory, because it does not affect a large enough surface and as a consequence the pieces will lodge at certain spots. If distributed under the inclined plane as shown at *L*, *M*, and *N*, a better action will be found. It is, of course, important to study carefully the supporting points of the plate and place the vibrators at points where they will have the greatest effect.

* * *

REGIONAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A regional meeting of the American Society of Mechanical Engineers will be held June 22 to 25 at Portland, Oregon. All the sections of the society located on the Pacific coast will participate in this meeting. The meeting will occupy four full days. There will be two technical sessions, and among the papers to be presented will be one on suction Diesel dredges and on the mechanical engineering features of the Long Bell Lumber Co.'s new saw mill at Longview, Wash. Hydro-electric power plants, electric logging, steam logging, and cable systems in recent logging developments will also be included among the papers scheduled for the meeting.

* * *

A manufacturer of power-press guards tells of a curious condition that affects the demand for this product. He says that whenever the inspection authorities of any one of the leading industrial states become more active and start a campaign insisting upon proper power-press guards, it immediately reflects in the demand for his product. When there is less activity on the part of the authorities, there is immediately a falling off in his business.

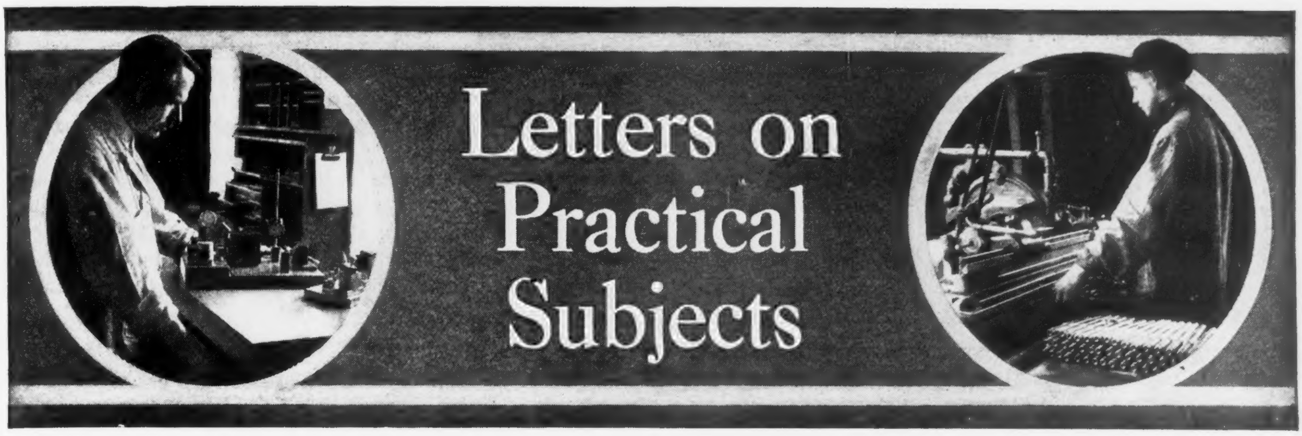
THE GERMAN MACHINE INDUSTRY

The American Chamber of Commerce in Germany reports that the matter of credits and capital remains of supreme importance in the industrial field, and that the purchase of large machines requiring the outlay of considerable sums of money is very carefully considered and orders are placed with considerable hesitancy. While orders for the domestic market are therefore quite limited, orders from foreign countries are still more scarce. High import duties in foreign markets are given as one of the primary causes for the decline in the export business, the increase in prices of all materials also causing some concern to German manufacturers. There have been marked increases in the prices of sheet steel, steel scrap, and steel bars. These rising prices for raw materials will doubtless have a retarding influence on the machinery business, as it is considered impossible for German manufacturers to increase prices of manufactured machines correspondingly, because of keen competition at home and abroad. According to index figures given in "German Trade Reports and Opportunities," published by the American Chamber of Commerce in Germany, the wholesale prices in Germany at the present time, figured on a gold basis and compared with prices in 1913, are 44 per cent higher than they were in that year for sixteen leading products in the iron, steel, metal, and coal branches of industry. The prices of industrial manufactured products, the index figures being based upon the prices of twenty-two articles, are 32 per cent higher than in 1913. An average of the 107 products considered in making the comparison shows an increase of 41 per cent in prices since 1913, all comparisons being on a gold basis.

The idea that Germany is flooding the world with machine tools because of the low labor costs in that country appears, from all available reports, to be erroneous, according to the Department of Commerce. While Italy, for example, is still one of Germany's most important markets for industrial machinery, especially metal-working machinery, the sales in Italy at present are far below the pre-war sales. In 1913, Germany shipped to Italy 5700 metric tons of machine tools, while during the first ten months of 1924, the sales decreased to 1625 metric tons. The machine tool exports of Germany, to all countries, as measured in metric tons, were only one-half in 1924 what they were in 1913. On the other hand, during 1924 Germany imported over twice the value of metal-working machinery from the United States that was imported in 1923. Of the imports, grinding machines led all the rest, the value being $243,000, as compared with $24,600 in 1923. Gear-cutting machinery came second, the value being $123,000, as compared with $40,000 in 1923.

* * *

Forty-three General Electric Co. employes recently received the Charles A. Coffin Foundation awards for having made the most important contributions toward increasing the company's efficiency or progress in the electrical industry during 1924. Twelve of the prizes were won by shop men, five by foremen, fifteen by engineers, and seven by commercial men. Four special awards were made for the presentation of papers at company meetings. With each award there was a prize of $250. In addition to these awards, the General Electric Co. during 1924 distributed $39,531 to 3244 employes for suggestions that increased the efficiency of the company's operations. The suggestions ranged from those covering safety devices for the protection of workers to ideas on improved methods of manufacturing electrical apparatus. The awards ranged from $1 to $1000. The suggestion system in the General Electric Co.'s plant works briefly, as follows: Suggestions are sent to a special committee in each plant. This committee investigates the suggestion, passes upon its merit and either makes an award or explains why the suggestion cannot be adopted. In most cases the award is made within a few weeks after the suggestion is received; but, where it is necessary to put the suggestion into practice in order to determine its value, a longer time must elapse.



METHOD OF ALIGNING LARGE CYLINDERS

The problem of properly setting the cylinders of a large compressor of the tandem type with independent foundations for the steam and compressor ends was solved in one plant by means of simple equipment which can be made up and used to advantage wherever the problem of placing two cylinders on the same center line occurs. The equipment consisted of two standards, several measuring pieces, and a chalk line.

The stands were made up from pieces of 1-inch boards, about 5 inches wide, mounted on a foot made from a piece of 2-inch plank. The upright piece *A* is made with a hole in its upper end to take a bolt at an elevation corresponding approximately with the height of the center line of the machine above the floor in the engine room. Attached at this point is a second piece *B* of the 1-inch material, about 15 inches long, which has a saw-slot cut longitudinally along the center for a distance of about two-thirds of its length.

The measuring pieces (not shown) are made from sticks of wood about ½ inch square. These pieces are cut to lengths about 1 inch shorter than the radii *C*, *D*, *E*, and *F* of the various cylinders of the machine, and are given blunt points on each end. Driven into the ends are common pins to make up the remainder of the length, which is equal to the radii of the cylinders. These pins permit of adjustment to an exact length in that they can be driven in or pulled out a little.

The method of setting up and using the apparatus is shown in the illustration. The two stands *A* are set near the center line of the cylinders at each end of the machine. The chalk line is stretched tightly from one to the other, being fastened in the slots of the standards. The bolt at the top of the stands permits the arm to be moved slightly and at the same time remain in any position in which it is placed. This is done until the line is approximately on the center line of the steam cylinder. Then the measuring stick is used at points *G* and *H* to determine whether or not the line is equidistant from the cylinder walls, and if it is not, the line is moved until it coincides with the center line of the steam cylinder.

The compressor end next comes in for attention. The cylinder is moved into approximately the correct position, and the distance to the walls at points *J* and *K* measured. Then this cylinder is moved and wedged into position until the walls of the cylinder are equidistant from the line. When this condition exists, the compressor cylinder is grouted in place, and the machine is ready to receive the piston-rod and pistons.

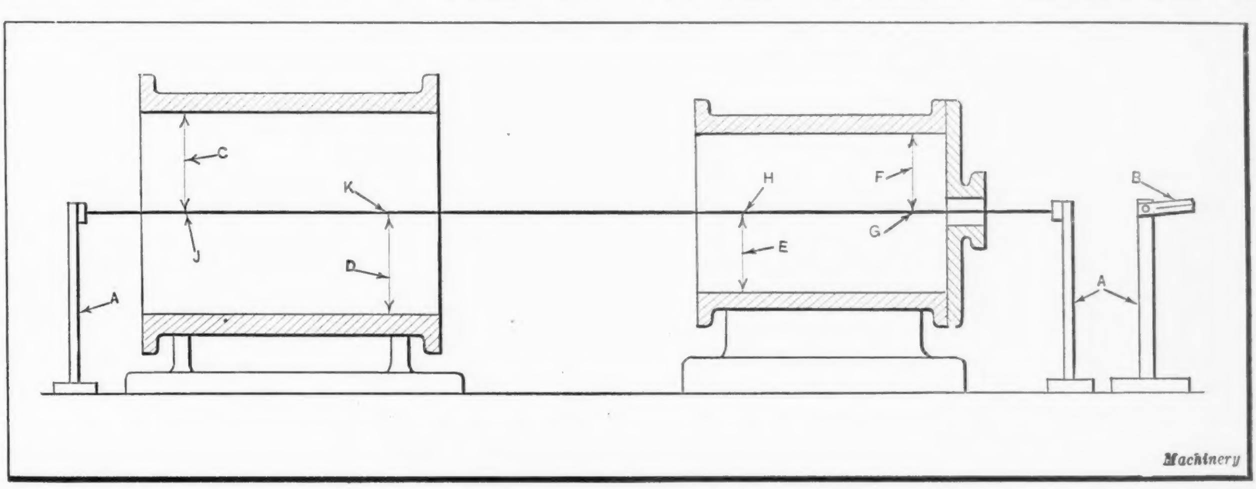
Pittsburg, Pa. SIDNEY K. EASTWOOD

PLATE CAM BLANKING DIE

The die shown in the accompanying illustration is easily constructed, and with it, plate cams can be rough-formed in a fraction of the time that is necessary to accomplish the same work by the drilling-out method. In fact, a plate cam can be roughed out with this die in about half the time that would be required merely to lay out the centers of the drill holes around the outline of the cam shape—an operation which it also eliminates—and when the job is done, much less work is required to grind or mill off the remaining projections, for the reason that successive punchings can overlap each other to almost any desired extent so that very little remains in the way of superfluous metal.

The die illustrated was primarily designed for the blanking out of cams for the Nos. 00, 0, and 2 Brown & Sharpe automatic screw machines, but it is plain that it can also be put to other uses. In working on cams, the saving effected is so great that a few sets made with it will pay for the entire cost of the die. After a little practice, a workman can easily complete ten sets of cams ready for finishing, in the time required for one by the drilling method.

The chief novelty, as well as the high efficiency of the die, reside largely in the indicator *A*, which permits the quick

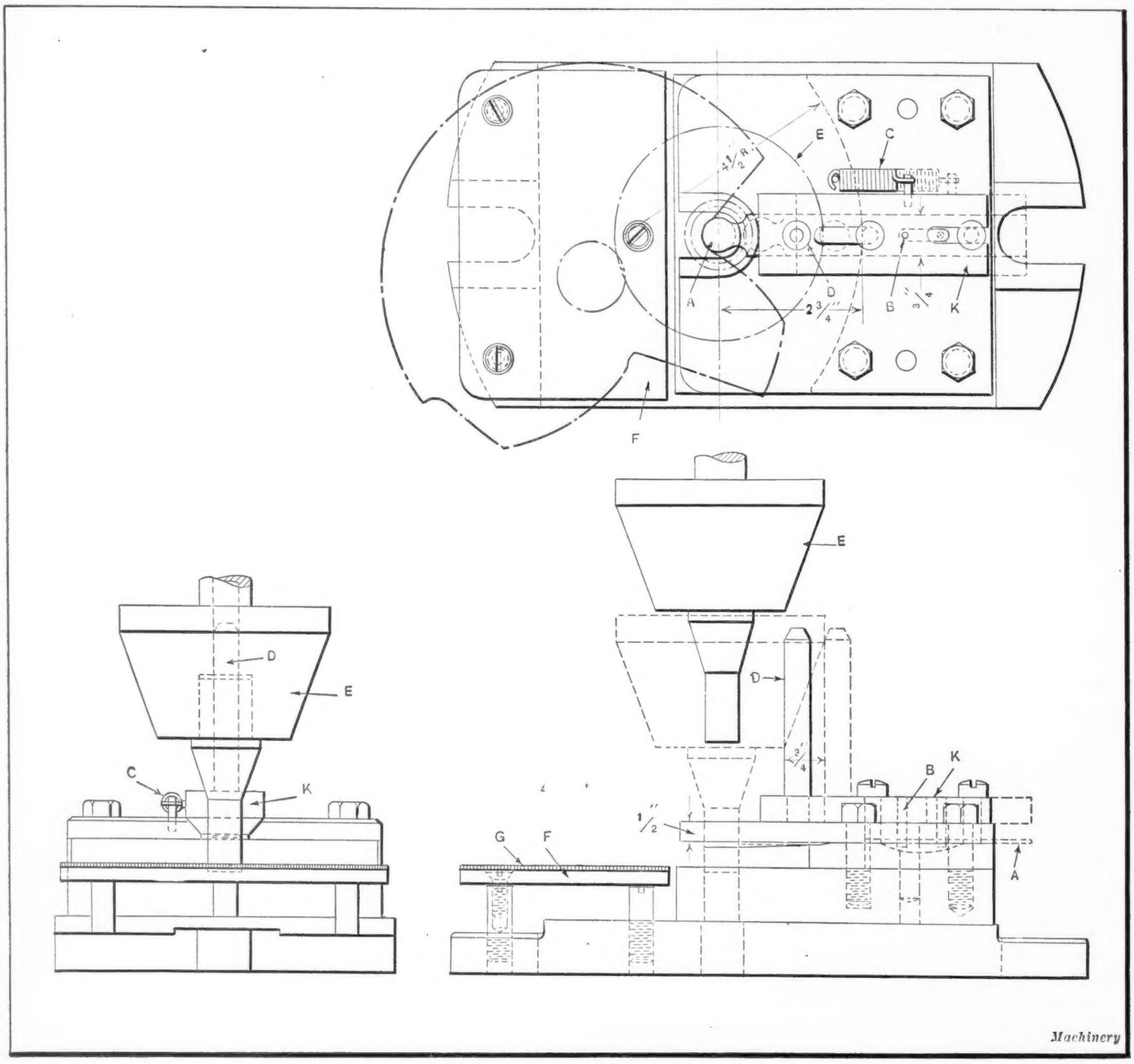


Method of aligning Cylinders of Tandem Type Compressor

and accurate location of the outline under the punch. The semicircular front end of this indicator always covers the die opening when the ram of the press is up, and it actually rests on the work, thereby making it possible to cut to within 1/64 inch of the line. This indicator automatically "sidesteps" when the punch descends, a feature which, together with the fact that all parts are so placed that the work is visible at all times, renders possible the close accuracy and rapid action of the device.

Coming down to details of construction, the die consists of an ordinary plain shoe, to which the die-plate is held by four screws from the bottom (not shown in the illustration). The die-plate itself extends well back on the shoe, to give a good footing for the stripper and accessories, but in front it projects only about ¾ inch beyond the hole. The stripper plate rests on a broad spacer plate, formed with a concave, semicircular front edge which is so related to the die hole as to permit a 9-inch cam to be perforated to a maximum depth of 3 inches, while the proportions of the plate itself are such as to insure a good stripping action, no matter how the cam may be shaped.

The indicator is made from a strip of 0.012-inch spring bronze sheet, ¾ inch wide, and is a close running fit in a shallow groove, about 1/32 inch deep, in the bottom of the stripper plate. At the front end, the indicator is bent so as to just rest lightly on the work when the ram of the press is up, but to rise as soon as it starts to run back. This arrangement, while it insures the disk of the indicator resting right on the work while the latter is being located, prevents collision between the two, and the "stubbing" of the indicator. The movement of the indicator backward is controlled by the sliding plate *K*, which imparts its run of ¾ inch to the indicator by means of a pin *B* driven into the sliding plate and passing through a hole in the indicator, the spacer plate being grooved for the travel of the pin. The return of the indicator is caused by a spring *C*, and the indicator slide is guided and held from coming up by two fillister-head screws passing through longitudinal slots formed in the body of the former.



Punch and Die for cutting Plate Cams from Sheet Metal

The sliding plate and indicator are actuated by the hardened pin *D* coming in contact with the beveled body of the round punch-holder *E*, the difference between the radii of the large and small ends of the tapered holder being slightly less than the travel of the indicator slide, while the length of the conical portion is slightly less than the movement of the ram. The pin *D* is a force fit in a hole in the indicator slide near the front end of the latter member. As the punch-holder is conical and concentric with the punch, it follows that there is no likelihood of error in the setting of the two actuating contact members, for no matter how the punch-holder is turned, its beveled face must at all times register exactly the same with respect to the hole in the die, and therefore will cause exactly the same movement of the indicator slide.

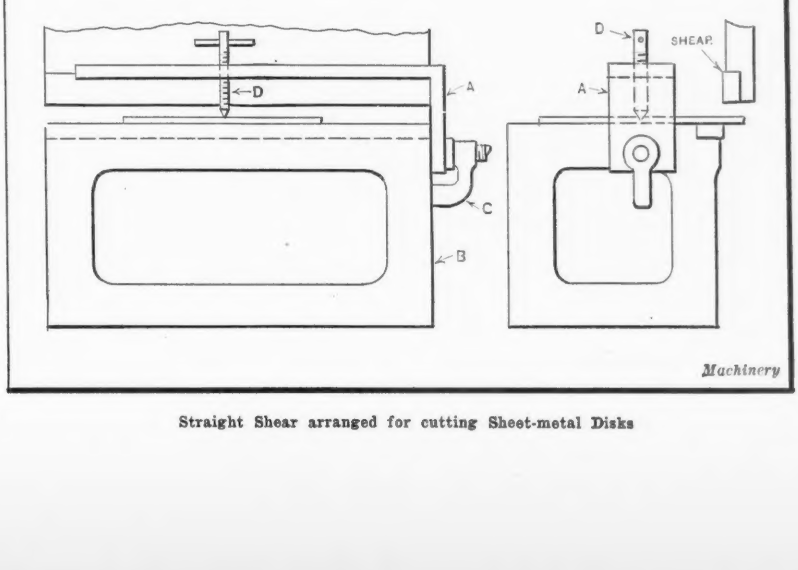
The last simple but quite important part of the die is the work-supporting plate *F*. Without this, the die would not be an unqualified success, for it not only provides a level support for the cam, but what is equally important, prevents the latter from slipping under the jarring of the press. These ends are attained by making the plate from hard fiber, with a glued-on plush cover *G* and resting it on three supports which can be screwed down into the die-shoe. These three supports or "legs" are simply headless screws threaded into the shoe, each being tapped for a V-headed screw which holds the plate to the leg.

In using the die, no oil or other lubricant should be employed. The punchings should be overlapped about half, which, as before mentioned, will leave only slight projections to be ground off. If the die and punch are kept reasonably sharp, no hesitation need be felt in punching quarter circles, such as are sometimes required in the edge of a cam, as there will be no perceivable slippage. The operation of the die is also perfectly safe, as the metal strips from the punch with great ease, and there is therefore no danger of accidents being caused by violent back-action against the stripper.

Santa Ana, Cal. HENRY SIMON

CUTTING CIRCULAR WORK WITH STRAIGHT SHEARS

An angle-piece, such as shown at *A* in the accompanying illustration, has been found of great assistance when using straight shears for cutting round or circular-shaped pieces from sheet metal by the nibbling process. The angle-piece is held to the body *B* of the lower shear by a clamp *C*. A pointed screw *D*, which is threaded to fit a tapped hole in angle-piece *A*, serves as a pivot around which the sheet metal can be revolved by hand in order to nibble or trim it to the required radius. For example, when trimming the piece *E* to the circular outline *F*, the angle-piece *A* is set so that the distance from screw *D* to the cutting edge of the shears is equal to the radius *R* of the piece. A punch-mark is made in the sheet metal to receive the point of screw *D*. When the sheet metal is in place, the shears are set in operation and the work is trimmed to the circular outline *F* as it is revolved about the point of screw *D*. Sheet-metal pieces of the shape indicated at *G* and *H*, as well as many other shapes involving circular outlines, can be readily cut out by this nibbing process.

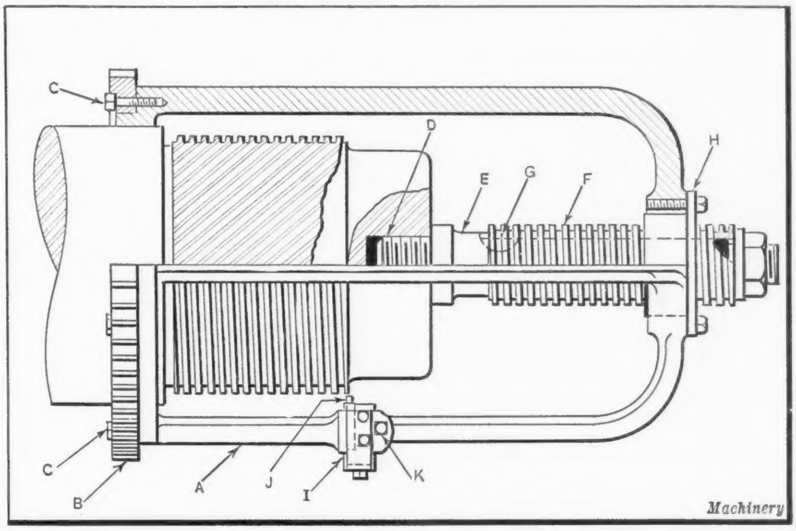


Straight Shear arranged for cutting Sheet-metal Disks

Philadelphia, Pa. CHARLES KUGLER

REPAIRING THREAD ON LARGE SHAFT

Assembly work on a field job frequently necessitates the exercise of considerable ingenuity and initiative on the part of those in charge. While visiting a large engineering project some time ago, the writer observed an unusual and interesting repair that was being made on a large shaft. The shaft was nearly 24 feet in length, about 30 inches in diameter at the largest portion, and weighed about 25 tons. The 20-inch diameter, 3/4-inch pitch square thread at one end of the shaft had been damaged to such an extent that it was practically useless. As there was no lathe available that was large enough to swing the shaft, the thread-cutting fixture described in the following was designed and built to handle the work.



Fixture used to cut Thread on a Large Shaft

A large spur gear was found in one of the local plants which was cut out and bored to fit the four-ribbed yoke *A*. The yoke *A* was designed to permit the large end to be bored out to a sliding fit over the cylindrical portion of the shaft just back of the threaded section. The bore of the ring gear *B* was fitted over a shoulder and held in place on the yoke by screws *C*. The end of the large shaft was provided with an internal thread at *D*, into which a short piece of shaft *E* was fitted. This shaft was turned to fit the long lead-screw bushing *F*, which was held in position by the key *G* and a nut and washer as shown.

The outer end of the yoke was bored to receive the nut *H* which was provided with a flange so that it could be secured to the face of the yoke. Two tool-blocks like the one shown at *I* were fitted into enlarged portions of two of the ribs of the yoke. Adjusting screws were provided in the tool-blocks to permit setting the tools *J* at the required distance from the center of the shaft. The cutting tools were held in place by two small cap-screws and a clamp, while the block was locked in position by the large screw *K*. By having two tool-blocks, a roughing cut could be

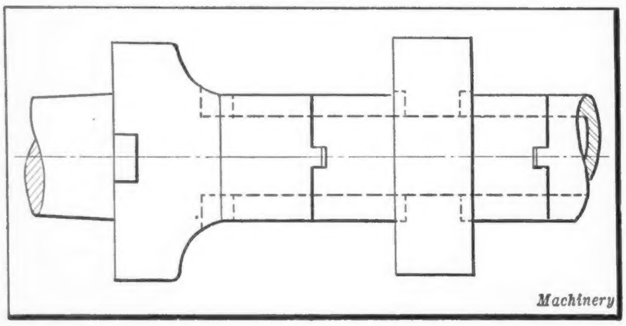
taken with a narrow tool in one block, while the tool in the following block finished the groove to size.

In connection with the thread-cutting operation, it may be well to mention that a fine-pitch lead-screw and nut was used when turning off or removing the old thread before cutting the new thread. The recess at the finishing end of the thread was made of sufficient width to allow ample clearance for both tools. The operation of cutting the thread was performed by raising the shaft on blocks until it cleared the floor, and then driving the yoke by means of a specially constructed geared countershaft, having a wide-faced pinion that provided for the lateral movement of the thread-cutting device.

JIM HENDERSON

EQUALIZED DRIVE FOR MILLING MACHINE ARBORS

The advantages of a balanced or equalized drive are apparent to all mechanics. Nevertheless, these advantages are generally ignored in the design of cutter-arbors for milling machines. These arbors are invariably made with a keyway on one side which is usually square and often too small to drive the cutter. With the conventional type of square key, the leverage or turning moment exerted on the cutter from its supporting arbor travels about the center or axis of the arbor, and therefore does not exert a constant pressure at the cutting point. This construction is responsible in a large measure for chatter of the cutter. Twisted, mutilated, and scored keyways are among the objectionable features of the key-driven arbor. Also, the collars often become badly injured and the cutters are needlessly broken, while the end clamping nut of the arbor, which is often compelled to exert more clamping pressure than it can stand, owing to the practice of leaving out the key altogether, soon loses its flat faces, and a pipe wrench must be used to tighten or loosen it. These conditions, which exist to a greater or lesser extent in many milling machine departments, emphasize the need for a change in the design of cutter-arbors.



Milling Machine Arbor with Equalizing Driving Collars

The milling machine is a precision machine capable of very accurate work, but in many cases it loses much of its value as a precision tool through the weakness of the cutter-arbor. The writer believes that the difficulties mentioned can be eliminated by the adoption of a complete balanced drive applied directly to the cutter from the collars, eliminating the key entirely from the arbor and thus strengthening and stiffening this part of the machine. The collars should have slots and lugs at their opposite ends, and the cutters should have mating slots in their sides to receive the lugs. The drive should originate from the main shoulder of the cutter-arbor, and be passed along through the collars to the cutter.

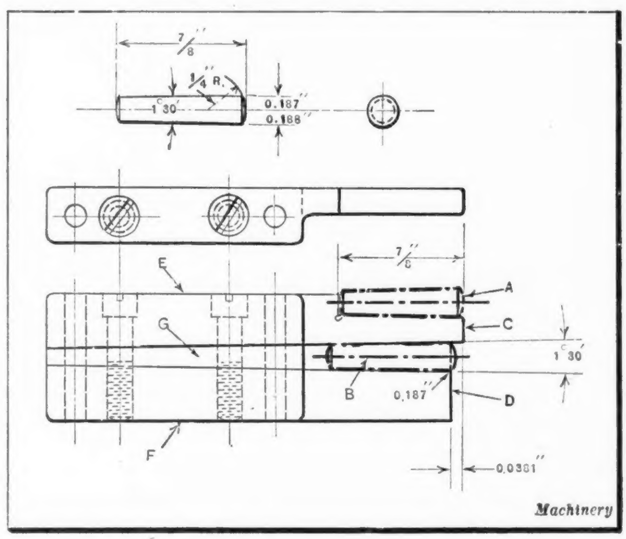
The advantages of the proposed construction will be readily appreciated: First, the arbor is greatly strengthened by the collars, which assume all the driving action, and the torque is thus appreciably reduced. Second, the drive is equalized and the chatter is reduced. Of still greater importance is the permanently improved condition of the arbor and its collars and the clamping nut. Scoring, twisting, and mutilating of the keyway will be eliminated, and the deforming of the clamping nut and the stripping of threads will occur less frequently, if at all. It must not be assumed, however, that all difficulties will be eliminated by adopting the proposed method of driving milling cutters, but they will undoubtedly be diminished by the use of a balanced drive of a form substantially as shown in the accompanying illustration.

Without going into specific details, it is suggested that the size and number of the slots and lugs on the collars be determined by the size of the arbor, double, triple, or quadruple lugs being used according to the diameter of the arbor. All parts should be of the proper grade of steel for the purpose, heat-treated and properly hardened. The collars should be well chamfered on their ends, internally and externally, and ground inside and out with good sliding fits on the arbor. Most important of all, their end surfaces should be absolutely parallel, so that an arbor, when assembled with the cutter and collars, and the nut properly tightened, will run within modern standards of truth, the error being less than half a thousandth. The making of the collars presents the most serious problem in carrying out the suggested improvement, but there should be no great difficulty in manufacturing these collars in the required sizes, once the task is undertaken.

Springfield, Vt. O. S. MARSHALL

TAPER-PIN LIMIT GAGE

A simple limit gage for inspecting taper pins is shown in the accompanying illustration. The taper pin is placed in the position shown at *A* to determine if the length is within the required limit. If the pin projects beyond the end of the gage it must be rejected. The diameter at the large end is inspected by placing the pin in the position shown at *B*. When this diameter is within the specified limits, the end of the pin will be located between the surfaces *C* and *D* of the gage. The gage is made up of three members, *E*, *F*, and



Gage for inspecting Taper Pin

G, which are doweled and held together by fillister-head screws.

The sides *E* and *F* are ground on the surfaces that are in contact with the ground wedge-shaped piece *G*. The ends of these pieces at *C* and *D* are also ground to produce the 0.0381-inch step. The length of this step is found by subtracting the minimum diameter (0.187 inch) of the large end from the maximum diameter (0.188 inch), dividing this result by 2, and multiplying by the cotangent of one-half the included angle of the taper pin.

Bridgeport, Conn. EDWARD A. NEVINS

* * *

In 1924, in accordance with statistics published by the National Automobile Chamber of Commerce, 726,000 carloads of automobiles and parts were shipped over the railroads of the United States.

STANDARD GRINDING WHEELS

The Grinding Wheel Manufacturers' Association of the United States and Canada, after working for five years in the endeavor to reduce the multitude of existing grinding wheel shapes and sizes to a reasonable number of practical standards such as would meet all normal requirements of the trade, have adopted a series of standard shapes and sizes for various classes of work. In this work of grinding wheel standardization, many difficulties arose owing to the extreme variety of existing types of grinding machine equipment. Due consideration, however, has been given not only to the machine equipment but to the demand for, service rendered by, composition, shape, manufacture, and use of each type of wheel.

An investigation of the general phases of the problem of wheel standardization led to the conclusion that the ultimate goal was to simplify wheel shapes and sizes by reducing their number to a minimum which would answer the requirements of present grinding practice and at the same time furnish a sound basis for future development. In engineering practice, widely diversified methods of accomplishing identical results have been employed. This has caused, in the abrasive field, as in others, variations which reflect only the numberless points of view in approaching a specific problem. The many variations in size, shape, and arbor hole dimensions have very little bearing on the basic engineering principles involved.

As a result, thousands of wheel shapes have been developed due to the fact that the industry as a whole had never taken steps to establish standards for the guidance of designers, machine builders, and users, but had accepted without question wheel designs as ordered. The extreme diversity of shapes and sizes created a condition which was so complicated that it affected wheel manufacturers, machine builders, and users alike, because adequate stocks of so great a variety of grinding wheels could not be carried economically. Under normal conditions it requires from six to eight weeks to process wheels, and delays due to inadequate stocks often seriously embarrass the user.

In order to determine the most suitable proportions and sizes for standard wheels, a complete list of existing sizes of each given type of wheel was compiled. These various wheels were checked against each other by a lay-out plan where sizes of a given diameter and similar shape were drawn one over the other. For example, a lay-out of this kind was made of a group of 6-inch dish wheels, all designed for cutter and reamer work, and so similar that any one of these could, with the proper arbor, be substituted for the other. There were no less than twenty-two 6-inch dish wheels to consider. This number was finally reduced to two.

By the elimination of inactive sizes (arrived at from the actual sales records of a number of manufacturers) only the popular selling sizes were left to be considered. From these a composite shape was designed, which should meet present-day machine requirements and satisfy the grinding wheel manufacturers. In this way internal wheels, dish wheels, straight wheels, flaring cups, and double cups were simplified. In no case was the thickness of wheels between flanges increased in the types of wheels just mentioned. However, a slight change was made in some of the shapes, but not enough to interfere with the proper mounting of the wheel. The bottom corners of recesses were rounded to give additional strength.

The first types to receive attention were the internal and cylinder grinding wheels. The troubles encountered were many because of the varying diameters controlled by the diameter of the holes to be ground; also because of the many existing arbor holes for the various internal production machines and internal attachments. With the cooperation and advice of the builders of internal and cylinder grinding machines, the committee, after three years of work, succeeded in having the present list of diameters and thicknesses approved. The following internal wheel dimensions were adopted:

Standard Diameters: 1/4, 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 3/4, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2, 2 3/4, 3, 3 1/2, and 4 inches.

Standard Thicknesses: 1/4, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/4, 1 1/2, 1 3/4, and 2 inches.

The following cylinder grinding wheels have been adopted as standard:

Diameters: 2 1/2, 2 3/4, 3, 3 1/2, 4, and 4 1/2 inches.

Thicknesses: 3/4, 1, and 1 1/4 inches.

The accompanying table is a summary of the committee's work on internal, cylinder grinding, and tool-room wheels, showing existing sizes, reduction, and possible stock saving. It is based on the lowest possible stock quantities for each type of wheel.

The total possible stock reduction by simplification equals 459,400 wheels. The reduced stock as given in the table for internal and cylinder grinding wheels, is based upon 500 wheels in each size in two grits and two grades. For the straight, flaring, and double cup-wheels there are 100 in each size in two grits and two grades, and for the dish wheels, 200 in each size in two grits and two grades.

Cylindrical grinding wheels were the last to be considered. Many different wheel sleeves had been designed, necessitating a large number of arbor holes and different counterbores. Close cooperation by some of the leading cylindrical

Type of Wheel	Number of Existing Shapes	Possible Stock	Reduced to	Reduced Stock	Possible Stock Saving
Internal.....	289	578,000	95	190,000	388,000
Cylinder.....	45	90,000	26	52,000	38,000
Straight cups	11	4,400	5	2,000	2,400
Flaring cups.	27	10,800	8	3,200	6,600
Dish wheels..	38	30,400	9	7,200	23,200
Double cups.	4	1,600	1	400	1,200

grinding machine manufacturers made it possible to standardize on three arbor holes, namely, 5-, 8-, and 12-inch holes. At the same time it was possible to make the diameter and depth of counterbore standard for all cylindrical grinding wheels thicker than 2 inches. One other step toward standardization was to reduce the existing types of all classes of wheels from twenty-nine to fourteen.

A 28-page booklet entitled "Standard Shapes of Grinding Wheels" has been prepared, which contains cross-sections of the fourteen standard types which are representative of practically all grinding wheels used on standard makes of grinding machines, and in addition, tables containing the important dimensions. The types of wheels are numbered from 1 to 14, and each dimension is designated by a letter, there being a key indicating the meaning of each letter. This classification of grinding wheels greatly simplifies the stocking of wheels, and also enables the user to order a grinding wheel by giving the type number and the complete dimensions for such a wheel as designated by its cross-section. Copies of this booklet may be had by writing to any member of the association.

* * *

The April number of the Journal of the Society of Automotive Engineers contains a complete review of the standardization activities of the various standards committees of the society. In an article entitled "Pan-American Standardization," Kirke K. Hoagg outlines the action taken at the Pan-American Standardization Conference held at Lima, Peru, at which were present seven delegates from the United States. Nine other articles relate to different standardization projects handled by the society at the present time.

* * *

Only 45 per cent of the money collected by the Federal Government in taxes placed on motor vehicle users, is expended on national road improvement.

The Machine-building Industries

STATISTICS compiled by the Department of Commerce and by various trade associations show that production is proceeding at a satisfactory rate—all the industries of the country being considered as a whole. The Federal Reserve Board's index of production in twenty-two basic industries, which is adjusted to allow for differences in the number of working days and for seasonal variations, declined slightly in February, the last month for which complete statistics are available, but continued to show a higher figure than at any time since the peak of production in May, 1923. The average daily output of iron and steel has been exceptionally heavy, and the daily copper production the largest since 1918. The production of automobiles has increased in a marked degree. Factory employment has been steadily increasing for the past months. The freight movements for the first three months of the year were the heaviest on record, and in recent weeks the shipments of merchandise have increased so that they are very much larger than a year ago.

The Machine Tool Industry

There has been no appreciable change in the conditions in the machine tool industry since the writing of this review last month, except that there is more definite activity in the foreign trade. Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, points out that statistics for various industries show production at about a normal rate, but with no evidence of any appreciable rate of expansion; for this reason, the machine tool industry depends rather upon replacement business than on new industrial developments, and hence is characterized by a limited demand. The war time capacity of the machine tool industry has been considerably reduced, and this reduction will doubtless continue until the capacity more nearly corresponds to the actual needs of the domestic and foreign markets for machine tool equipment. A favorable aspect in the industry is that stocks of machine tools in most cases are comparatively small and that most manufacturers, at the present rate of production, are selling all they produce. The increased activity in foreign business will have a tendency to make it possible to maintain this condition. There is also a great deal of prospective railroad business—as there has been for several years—but it is very slow to materialize.

The Small Tool Industry

In the small tool field conditions are considerably better than they have been for several years past. Most manufacturers of taps and dies state that there has been a healthy increase in their business, the last two months having shown a considerable improvement. The automobile companies have come back into the market. Great improvements have recently been made in the endurance capacity of taps through the use of high-speed steel. These improvements have been necessitated by the tendency to demand greater speed in tapping. There is also a tendency toward greater accuracy, which means an increasing demand for ground-thread taps. The use of low tungsten steel for taps has also increased to a considerable extent of late, and is reported to have given great satisfaction for certain purposes. There is a greater tendency to experiment with taps for different purposes and to differentiate between the heat-treatment and material for taps according to the service for which the tap is intended. The same also holds true of threading dies.

The demand for drills and milling cutters has improved, and the price situation, in the drill field especially, has become stabilized. Other small tools are also increasingly in demand and some makers state that the last month has been the best in three years. As might be expected, the demand for tool steel is also good, with prices more stabilized than last year. One leading dealer in tool steels is well satisfied with the situation and finds the business well distributed among all kinds of industries and all over the country.

The demand for grinding wheels is normal and the prospects in this field appear to most manufacturers of this product to be satisfactory. The gear cutting business, on the whole, appears to be in a favorable condition, both as regards industrial and automotive gears, with several of the plants running to capacity.

The Automobile Industry

According to the National Automobile Chamber of Commerce, the March production of automobiles was 362,305 cars and trucks, an increase of 29 per cent over February. The production in March this year is even slightly higher than the production in March, 1924. Stocks in dealers hands are reported light, and active production is expected for several months to come. Reports from foreign markets indicate that the exports this year will be the heaviest on record. The demand for trucks and buses this year has so far been larger than expected.

The official figures of the Department of Commerce on automobile registrations at the end of 1924 show a total of 17,591,981 cars and trucks in the United States—one for every 6.4 persons—an increase of over 2,500,000 during 1924. The capacity of the existing automobile plants has been estimated as somewhat more than 5,500,000 cars and trucks a year. Last year the output was about 3,500,000 cars and trucks and it is not expected that the production this year will be much, if any, greater than in 1924. In other words, while some plants will be operating to capacity, the entire industry as such, counting all existing plants, will not operate to more than about 65 per cent of capacity. In this respect the automobile industry—like so many others—has expanded far beyond the consuming capacity of the country.

The Iron and Steel Industry

Steel production was maintained during March at a higher daily average level than in February, and the daily average pig iron production was also slightly greater than during the preceding month, reaching the highest level since April, 1923. It is believed, however, that the March figures will mark the peak of present iron and steel production. The number of blast furnaces in operation at the end of the month was 246 as against 256 at the end of February. On this basis the blast furnaces in operation are now approximately 60 per cent of capacity, which has been termed "normal." Hand to mouth buying has become the general practice of consumers of steel, and while orders, therefore, will not be placed far ahead, there is no expectation of any sudden decline in buying. A slight reduction in prices is recorded both in steel products and in pig iron. It is stated that foreign steel is competing more and more with the domestic product on the Atlantic Coast, and that foreign steel can be bought from $6 to $8 under the domestic price. Importers estimate that 750,000 tons of foreign steel will be sold here this year.

While indications are for a decreased output of steel, it should be noted that some of the important industrial activities show a tendency toward increased use of steel products. The automobile industry will continue to be a heavy buyer for several months to come. The General Electric Co. reports that its orders for the first three months of the year amounted to nearly $84,000,000 as compared with $73,500,000 during the same period in 1924. The railroads have also placed large orders for equipment.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Garrison Hydraulic Gear Grinder

A NUMBER of new and distinctive features are embodied in the model B hydraulically operated machine which has recently been developed by the Garrison Gear Grinder Co., Dayton, Ohio, for grinding gear teeth on a production basis. Some of the principles of operation are the same as in the machine described in September, 1921, MACHINERY, but the methods of carrying out the principles have been improved, and the grinding of the teeth is accomplished in less time. As in the earlier machine, adjacent sides of two teeth are ground to the proper involute curve as the wheel is reciprocated between the teeth simultaneously with the slow rolling of the teeth transversely relative to the wheel. Any number of gears up to a total length of 6 3/8 inches can be mounted on the arbor at one time for grinding to a uniform tooth shape and pitch diameter. Thus, for example, the teeth of six gears of 1 inch face width can be ground in but slightly more time than is consumed in grinding a single gear 1 inch wide.

Particular attention was paid to producing a machine of rugged design that would eliminate vibration, and as a result the machine weighs about 4800 pounds. Construction details also reduce the tendency of parts to vibrate. A particular claim made for the machine is that it will grind gear teeth to predetermined sizes. A roughing cut is first taken all around the gear, then the grinding wheel is trued, and finally a finishing cut is taken over each tooth. With the exception of loading and starting, the machine is entirely automatic. Gears from 3 to 16 diametral pitch and from 1 1/2 to 9 inches pitch diameter can be ground. It is mentioned that the pitch diameter can be held to within 0.001 inch by the ordinary operator.

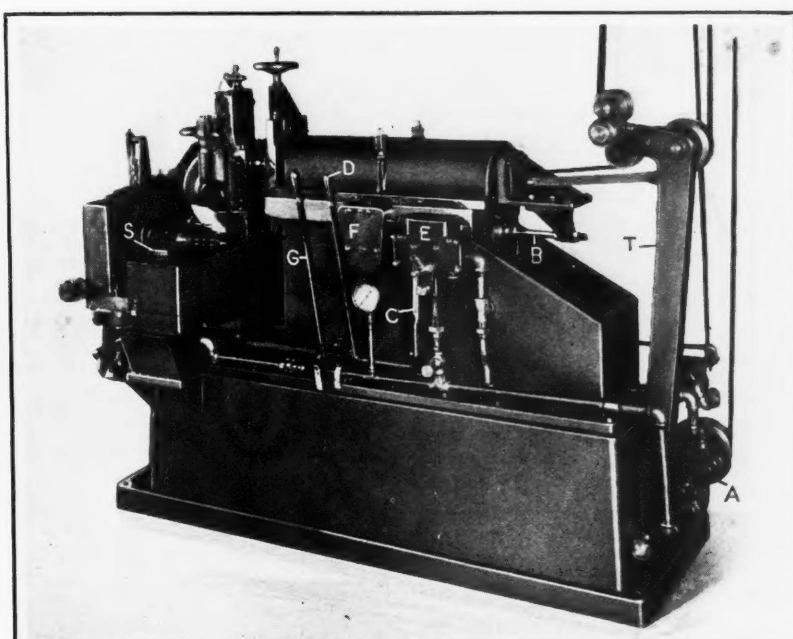


Fig. 1. Garrison Automatic Gear Grinder, which is operated hydraulically

The Hydraulic System

All movements of the machine, except the rotation of the grinding wheel, are obtained through a hydraulic oil system in which pressure is created by a Brown & Sharpe pump of the geared type, which is located at *A*, Fig. 1, and driven from an overhead lineshaft pulley. The oil is delivered through piping to two rotary motors mounted on the front of the machine and to a sliding motor or piston at the rear of the bed which actuates rod *B* connected to a bracket attached to the ram.

The delivery of oil to the cylinder of the ram-operating piston is governed by means of a valve operated through linkage *C* when lever *D* is operated to start the machine. With this valve open, oil is admitted into valve chest *E* from which its delivery into the cylinder, either in front or in back of the piston, is controlled by a slide-valve in the chest. This slide-valve is pulled back and forth by a lever in housing *F* which is tripped, as the ram reciprocates, by stops attached to the side of the ram. In this way, the positions of the stops control the length of the ram movements. Handle *G* can be employed to stop the machine at any point.

The two rotary motors, which actuate the table-traversing and the work-indexing mechanism, are located at *H* and *J*, respectively, in Fig. 2, which shows a close-up view of the parts at the front of the machine. The work-arbor extends through the front of the table as indicated at *K*, and on this end is mounted a master gear *L* of the same pitch and number of teeth as the work. The teeth of this gear mesh with rack *M*, which remains stationary as the table traverses back and forth, and so causes the master gear, work-arbor, and work to roll properly in relation to the wheel as they move sidewise with the table. The table movements are obtained by means of a pinion mounted on the shaft of motor *H* which engages a rack on the bottom of the table, the motor shaft being rotated alternately in opposite directions by admitting oil at regular intervals on opposite sides of the motor vane.

During each traverse of the table the grinding wheel reciprocates in only one tooth space. At the end of each table movement, motor *J* functions to raise the hinged rack arm *N* so as to bring the rack out of engagement with the master gear, and then the motor causes pawl *O* to index a ratchet on the work-arbor one tooth space. At the same time ratchet *P* is indexed one tooth. On the shaft of this ratchet is a dog, so positioned that when all the teeth of the work have been ground, a further movement of the ratchet shaft causes the dog to trip the rod on which levers *D* and *G* are mounted and thus automatically stop the machine.

The amount of oil delivered to motors *H* and *J* is governed by a cam-block on shaft *Q*. To change the speed of operation, it is merely necessary to turn this shaft slightly so as to depress or raise a link that controls the opening of the valve. The speed of the ram reciprocation is changed by turning a small screw which governs the opening of the valve that admits oil into valve chest *E*. There are only these two adjustments for the hydraulic system.

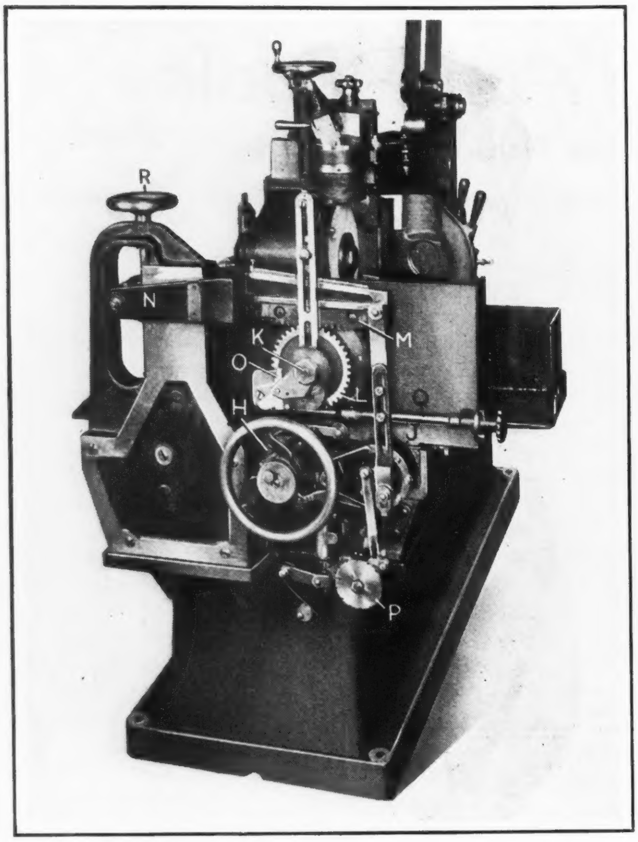


Fig. 2. Front View of the Gear-tooth Grinding Machine

The master gear must be changed for grinding the teeth of gears of different diametral pitches and pitch diameters, but the master rack is only changed for gears of different pitches. Whenever the master gear is changed for one of a different diameter, it is obviously necessary to lower or raise the master rack a corresponding amount. This is accomplished by turning handwheel *R* which engages a nut on the rack arm slide and adjusts the arm vertically on the housing of the machine.

In adapting the machine for grinding gears of a new size, one of the gears to be ground is carefully mounted on the arbor with the teeth in the proper relation to the grinding wheel, and then ground. After that, locater *S*, Fig. 1, is used for setting the work correctly on the arbor relative to the wheel. This device comprises six spring-actuated plungers, one or more of which are entered into a tooth space of the first gear ground. With the table moved to the right into the necessary position to accomplish this, a table stop is accurately set. All other gears of the same type can be conveniently placed on the arbor in the proper relation to the grinding wheel after the table has been moved against this stop.

As the wheel is dressed in each succeeding operation, the position of the wheel above the work must be adjusted, or else there will be a variation in the pitch diameter of the gear. To permit this, the wheel-head is adjustably mounted on the face of the ram. After the first gear of a lot has been ground, the graduated collars of the wheel dresser and wheel-head are set to zero. Then in succeeding operations, when the wheel dresser slide is lowered say 0.003 inch, and the dresser applied to the wheel, the wheel-head is lowered a corresponding amount as read from its graduated collar, to make the necessary compensation.

The Wheel Dresser and the Wheel Drive

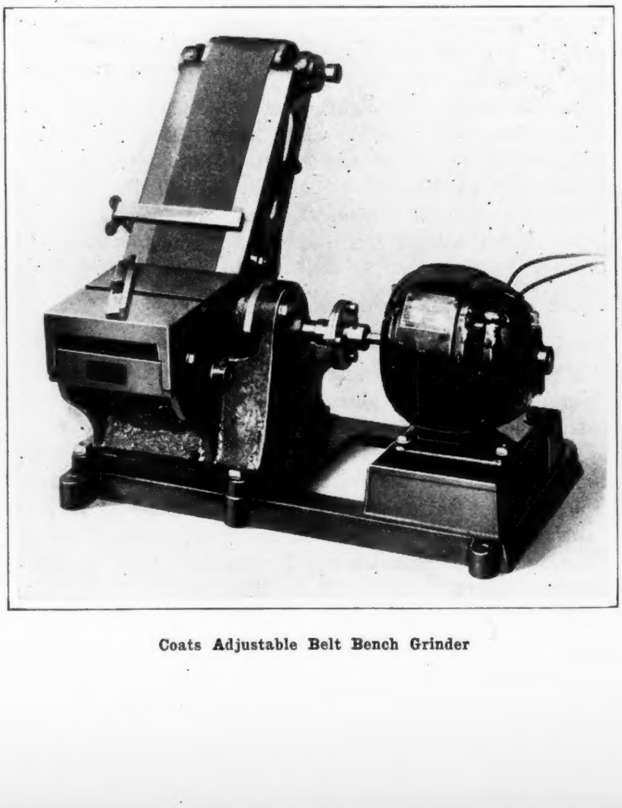
The wheel dresser can be readily set for dressing wheels to grind gears of from 3 to 16 diametral pitch and of any pressure angle from 8 to 25 degrees. Two diamonds are mounted in the device, one for dressing the periphery of the wheel and the other for dressing both angular sides. To facilitate setting the diamond to dress the wheel sides, the dresser slide is swung into the necessary position, which can be determined from graduations on the device.

In the wheel-truing operation, the dresser slide is moved up and down with the device in a locked position for dressing one side of the wheel. Then with the dresser slide raised to a stop, the device is turned 180 degrees in a horizontal plane into a second locked position, and during this movement the second diamond trues the periphery. With the device in the second locked position, the dresser bar is moved up and down to true the other angular side of the wheel. The dressing is performed previous to each finish-grinding. A 10- by 1/2-inch wheel can be used down to a diameter of 6 inches.

Another feature of the machine is the drive to the grinding wheel. Power is delivered by belt from an overhead cone pulley, the belt passing over a 5-inch idler on a hinged bracket *T*, Fig. 1, then forward to the wheel-spindle and back over two small idler pulleys. The last of these pulleys is mounted on a stud which is turned slightly to compensate for shifting the belt on the different cones of the driving pulley. Bracket *T* is attached to the ram, and swings forward and backward as the ram reciprocates so as to maintain approximately the same distance between the grinding spindle and the idlers. The arrangement also eliminates any upward pull on the wheel-spindle. The ram slides on one flat way and one vee, and rides on a constant film of oil, and the ram and head together, weigh about 450 pounds. These factors eliminate vibration in the operation of the grinding wheel and the ram, and all shock at the end of the ram movements is obviated by relief valves on chest *E*. The ram is usually operated at a speed of 50 feet per minute, regardless of the length of stroke. The wheel-spindle has a vertical movement of 5 inches, and in the extreme upper and lower positions, it is 2 1/2 inches above and below, respectively, the ways of the ram. A pump driven by the same belt that drives the hydraulic system delivers coolant to the grinding wheel and work.

COATS ADJUSTABLE BENCH GRINDER

An adjustable belt bench grinder designed for producing a straight-grain finish on castings made of iron, steel, brass, gunmetal, and aluminum, and other metal parts, as well as for grinding and polishing bone, fiber, and horn goods, vulcanized rubber, celluloid, wood, and similar materials, has been placed on the market by the Coats Machine Tool Co., Inc., 112 W. 40th St., New York City. The grinding table of the machine can be adjusted from a horizontal to a vertical position by means of two screws, and a graduated



Coats Adjustable Belt Bench Grinder

quadrant is provided near the fulcrum point, as may be seen in the illustration, to facilitate setting the table at any angle. This feature is of advantage on such operations as the grinding of hexagon nuts at any desired angle, the rounding off of sharp corners, and the grinding of cubes, strips, etc. The horizontal table, for use when grinding angular work, is reversible.

Correct band tension is automatically obtained by means of a movable weight which also prevents the band from slipping off. Abrasive bands for metal and wood grinding may be supplied for use with the machine, as well as belts of special leather for polishing with rouge or other fine abrasive powder. The abrasive band is 4 inches wide by 38 7/8 inches long; the size of the grinding table is 6 3/4 by 12¼ inches, and of the horizontal table support, 6¾ by 7 7/8 inches. The machine may be operated at a speed of from 500 to 1200 revolutions per minute, and the approximate net weight of the machine is 110 pounds.

CINCINNATI VERTICAL AUTOMATIC

Five different operations, such as drilling, tapping, turning, facing, and chasing can be done simultaneously on a piece of work in a vertical automatic machine that is being placed on the market by the Cincinnati Engineering Tool Co., 4659 Spring Grove Ave., Cincinnati, Ohio. There are six stations on the table, one of which is used for loading, a part being finished complete at each indexing of the machine. In the operations illustrated in Figs. 1 and 2, which are performed on a faucet stem, the sequence is as follows: Load, hollow-mill, knurl, chase, drill one end, and tap this end. The production averages twelve stems per minute.

A unique guard can be placed over the hollow mill to prevent chips from flying and to guide them into a receptacle placed beside the machine. This eliminates the necessity of removing chips from the pan and tying up production for the time being. The work-holding chucks are mechanically opened and closed by the indexing action of the machine, and so the operator only has to remove the finished parts and insert rough castings.

There are two turrets in the lower part of the machine, and on the upper one of these, the six work-holding fixtures are mounted. The lower turret is equipped with cams that feed the work-holding fixtures to the tool-spindles. Both turrets index in a counter-clockwise direction as one unit, being locked together by a ratchet plunger. At the end of

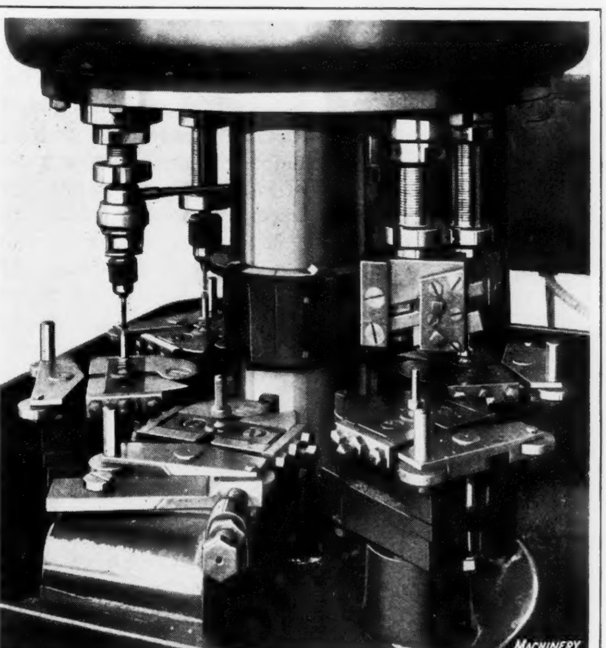


Fig. 1. Close-up View of the Tool-spindles and the Work-holding Fixtures on the Cincinnati Vertical Automatic

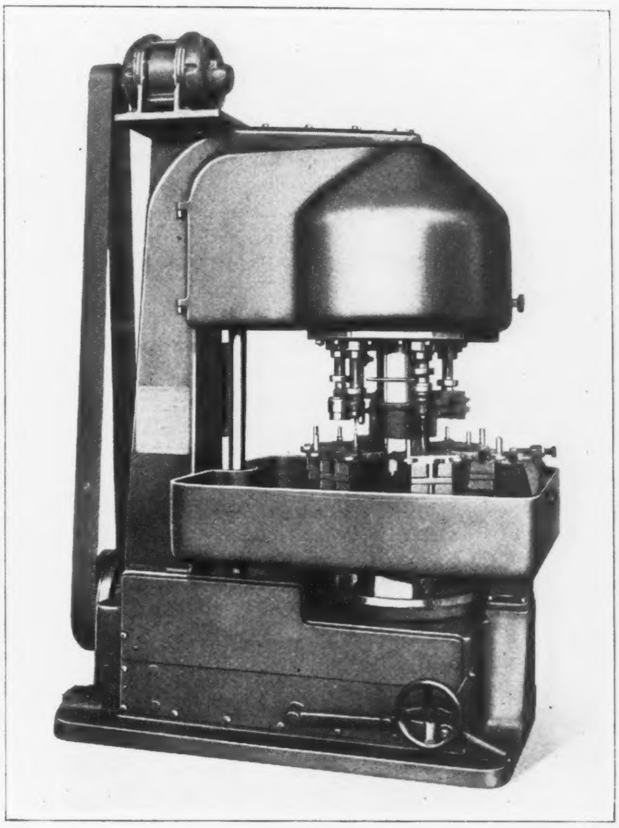


Fig. 2. Vertical Automatic Machine developed by the Cincinnati Engineering Tool Co.

the indexing as one unit, the upper turret is locked by a taper plunger to hold it stationary, and then the lower turret reverses. In this reverse movement, the cams of the lower turret raise the work-holding chucks for the operation and then lower them. At the completion of this reverse travel, the upper and lower turrets are again locked together by the ratchet plunger, and the taper plunger is withdrawn. Then the upper and lower turrets again index as one unit to bring the feed-cams back into the proper position for starting the feed on the next cycle, and to bring new pieces of work under the tool-spindles.

During the time that the two turrets index together, the chuck in which the rough casting has just been placed is automatically closed. A spring bumper in each chuck takes up inequalities in the rough castings, and serves to release the jaws from the finished work. Each chuck is fed in the different steps at an individual rate that suits the conditions of the operation performed at that station. In the case of tapping or threading operations, the work is fed according to the lead of the thread, which is said to insure accurate threads by eliminating strain on the chasing tools. As soon as the work has been fed to the proper height, the lower turret pulls the particular chuck back to its low position.

Spindle speeds can be changed from 160 to 1800 revolutions per minute by changing gears and swinging them into mesh by rotating the spindle box and clamping it with screws. The feeds are altered by changing the individual cams on the lower turret, which can be accomplished after loosening several nuts. It is said that a complete set of cams can be replaced in five minutes. Adjustment of the spindles for height is accomplished by turning nuts on the bottom end of the spindles. The spindles are locked after the adjustment to hold them in the desired positions. Draw-in bolts are used to hold the tools in the spindles, and these bolts are of such design as to prevent the tools from shifting out of position during the operation of the machine. The tools are driven by face keys instead of by a tang on the shanks. The drive to the machine is through a friction clutch equipped with a brake. The machine is started and stopped by operating a foot-treadle and can easily be stopped to prevent tools breaking in case of an improper set-up.

POTTER & JOHNSTON "UNIMATIC"

The latest addition to the line of automatic chucking machines manufactured by the Potter & Johnston Machine Co., Pawtucket, R. I., is known as the "Unimatic." This machine is built in several different models to suit a large variety of manufacturing processes. The different models consist essentially of the standard unit shown in Fig. 1, with different features added to adapt them to the work for which they are individually intended. Turning, boring, and facing cuts may be taken on parts. The machine is built in the form of a circular unit that is carried in an outer case or housing. This circular unit encloses all of the principal operating mechanism, is readily removable from the outer housing, and is independently motor-driven. An oil-pump provides a continuous bath of lubricant to all gears and bearings in the unit. For the average job, a motor of from 5 to 7 1/2 horsepower capacity is recommended.

The machine is intended for use on parts made in large quantities, where the design of the part is sufficiently stabilized to practically insure a continuous operation of the machine on one job. The spindle speed and the turning, facing, and boring feeds are fixed, although if it is desirable at any time to make alterations in these factors, it is convenient to do so within reasonable limits. The idle movement of the machine is made short by arranging the contour of the cams to suit the work. In cases where more or less frequent change-overs in the work are necessary, a constant accelerated motion is incorporated in the machine. In conjunction with this feature, pick-off speed and feed gears are provided, which make a change in the set-up a simple operation.

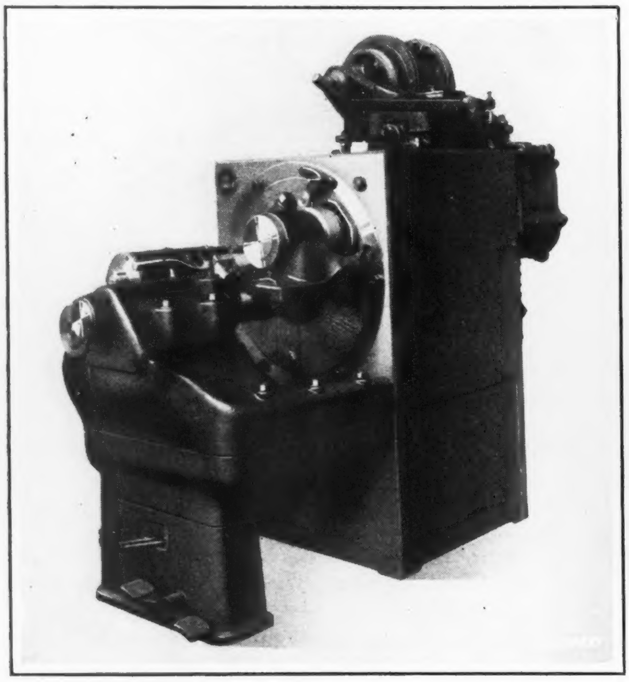


Fig. 1. Potter & Johnston "Unimatic" Chucking Machine

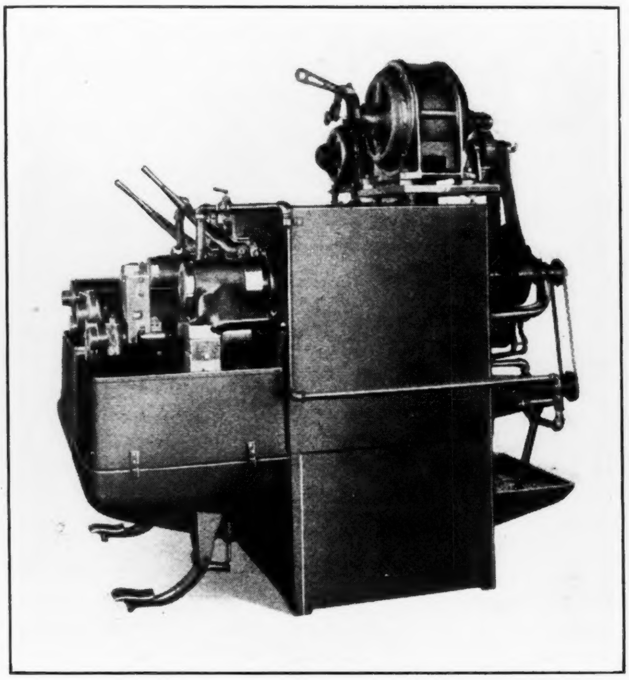


Fig. 2. Another Model of the "Unimatic" Chucking Machine

For machining work between centers, a rigid center unit is mounted in the machine on ball bearings. This unit is air-operated and has a 2-inch movement. In addition to this range, the center base has an adjustment on the machine bed that covers any size of work within the capacity of the turning slide. When chucking work is to be handled, the use of a 9-inch chuck, preferably pneumatically operated by an 8-inch air cylinder, is recommended.

Alloy steel hardened gears and shafts are used throughout, and all wear at points where cast-iron ways are usually employed is taken by hardened steel surfaces. End thrust on the spindle, end pressure on the turning slide, and side thrust on the facing swing-arm are taken by ball bearings. As shown in Fig. 2, each unit is provided with a chip pan of liberal dimensions, for which there is a clear passage underneath the machine proper to facilitate the removal of the chips at the rear. When the machine is to handle steel or other work requiring the supply of coolant to the cutting tools, a pump of large capacity is provided to direct an adequate flow from a tank cast integral with the pan base.

The "Unimatic" swings work up to 9 inches in diameter; the total travel of the turning and boring slide is 7 1/8 inches; and the facing travel of the swing-arm is 4 1/2 inches. The machine is designed for operation singly or in batteries, the outer casing being finished all over to permit several units to be placed snugly together. A spindle-to-spindle center distance of 31 1/4 inches can be obtained.

STARRETT TOOLS

Recognizing the need in the automobile repair trade and certain branches of the machine tool construction field for a long-leaf thickness or feeler gage, the L. S. Starrett Co., Athol, Mass., has just brought out a gage with eight leaves that are 9 inches long by 1/2 inch wide. They are of the following thicknesses: 0.002, 0.003, 0.004, 0.005, 0.006, 0.008, 0.010, and 0.015 inch. If one of the leaves becomes damaged in any way, it can easily be replaced. The possibilities of this gage will be particularly appreciated in honing or regrinding automobile cylinders to take over-size pistons.

Another new Starrett tool of interest to automobile repair men, electricians, or other mechanics who require a hand hacksaw for use in cramped quarters, is a hacksaw frame that will take any length blade from 8 to 12 inches. This frame has a handle which may be adjusted to thirteen positive locking positions to suit working conditions. In addition, the saw may be quickly set to cut in any one of four directions.

GODDARD & GODDARD METAL-SLITTING SAWS

Metal slitting saws in which the sides of the teeth are provided with sufficient clearance to carry all chips from the cut have been developed by the Goddard & Goddard Co., Detroit, Mich. With this design, chips will not clog as they often do, and cause a saw to "seize" and break a key or a section of the saw. Another feature of the design is that the portion of the saw that seats on the arbor is just as wide as the saw at the periphery.

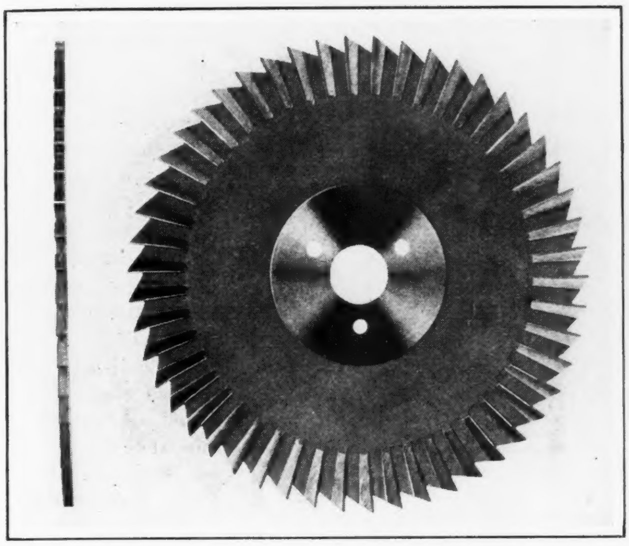


Fig. 1. Goddard & Goddard Side Chip-clearance Saw for cutting Cast Iron

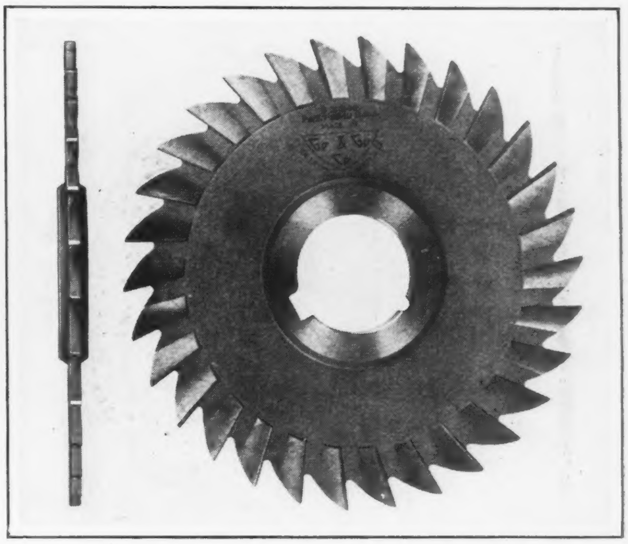


Fig. 2. "Go & Go" Style B Side Chip-clearance Saw made for slitting Steel

Fig. 1 shows a style A saw, intended for cutting off or slotting cast iron of any thickness up to the distance from the tip of the teeth to the hub. It is also recommended for use to a moderate depth in steel. The shallow clearance spaces cut in the sides of the rim can be readily observed. This saw can be used at a peripheral speed of from 70 to 90 feet per minute when cutting cast iron and fed at the rate of from 3 to 6 inches per minute.

The manufacturer of these saws contends that for cutting steel or other metals that curl into a long continuous chip, the saw teeth should be of the same design as a parting or cutting-off tool used for the same purpose in a lathe. Also, that there should be suitable space between the cutting face of one tooth, the back of the preceding tooth, and the enclosing metal, to afford room for this curled chip without its becoming cramped. The style B saw, illustrated in Fig. 2, is intended for work of this sort. With the increased power required for cutting steel, the saw also generally needs an increased bearing on the arbor to afford greater rigidity and give a longer bearing surface for the key. For this reason the saw is made with a reinforced hub.

In cutting mild steel with this saw, a suitable peripheral speed is about 125 feet per minute, and a feed of from 6 to 8 inches per minute should be used, but in cutting hard alloy steels, the peripheral speed should be as low as 60 feet per minute, and the feed from 3/4 to 2 inches per minute. Brass may be cut at a speed up to 250 feet per minute, with a feed of from 10 to 12 inches per minute. This style of saw is not made thinner than 1/8 inch, as the web between the teeth would become too thin.

For cases where a heavier saw having a thickness of 1/4 inch or more can be used in cutting steel, the style C saw shown in Fig. 3 is made. This saw has alternate teeth, which make it free-cutting and permit heavier feeds to be used than are possible with the saws already mentioned. This saw is also made with reinforced hubs to make it strong enough for driving to the limit.

In Fig. 4 is shown a style D saw made for cutting copper and aluminum, for which metals the saw teeth should have an increased shear, a coarser pitch, an increased heel clearance, and a larger fillet. There should also be a highly polished surface on the face of the cutting tooth and in the fillet to allow the ribbon-like chip to slide easily over the face of the tooth; otherwise the chip will cold-weld on the point of the tooth, or lodge in the fillet and clog the saw. A peripheral speed of from 150 to 300 feet per minute is suitable for cutting copper and from 500 to 700 feet per minute for cutting aluminum. A feed of from 12 to 20 inches per minute is possible with both copper and aluminum.

EX-CELL-O DRILL JIG BUSHINGS

Two additions have been made to the line of standard drill jig bushings made by the Ex-Cell-O Tool & Mfg. Co., 1469 E. Grand Blvd., Detroit, Mich. These additions consist of two plain headless press-fit bushings. The first is stocked in all number and letter sizes of drills and in fractional inch sizes from 1 to 1 1/4 inches in increments of 1/64 inch, and from 1 1/4 up to and including 2 inches, in increments

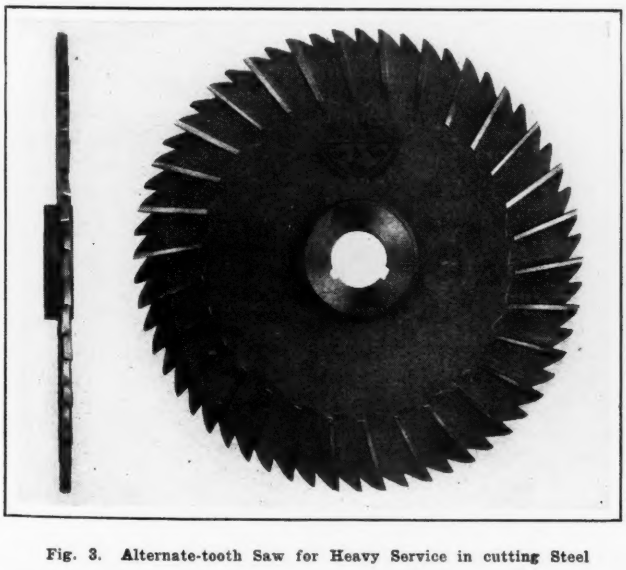


Fig. 3. Alternate-tooth Saw for Heavy Service in cutting Steel

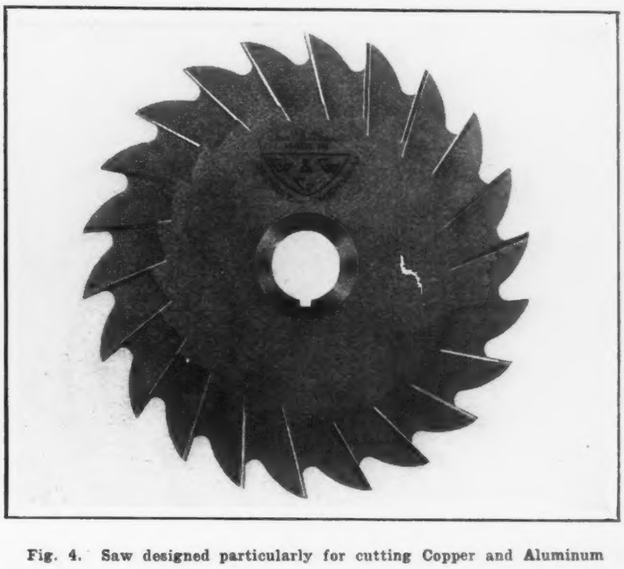


Fig. 4. Saw designed particularly for cutting Copper and Aluminum

of 1/32 inch. Each size is made in three lengths, and the sizes are so grouped that there are only eight outside diameters in the entire series. These outside diameters are such that the jig plate with which the bushings are to be used can be bored to a standard plug gage such as 3/8, 1/2, 3/4, 1 inch, etc.

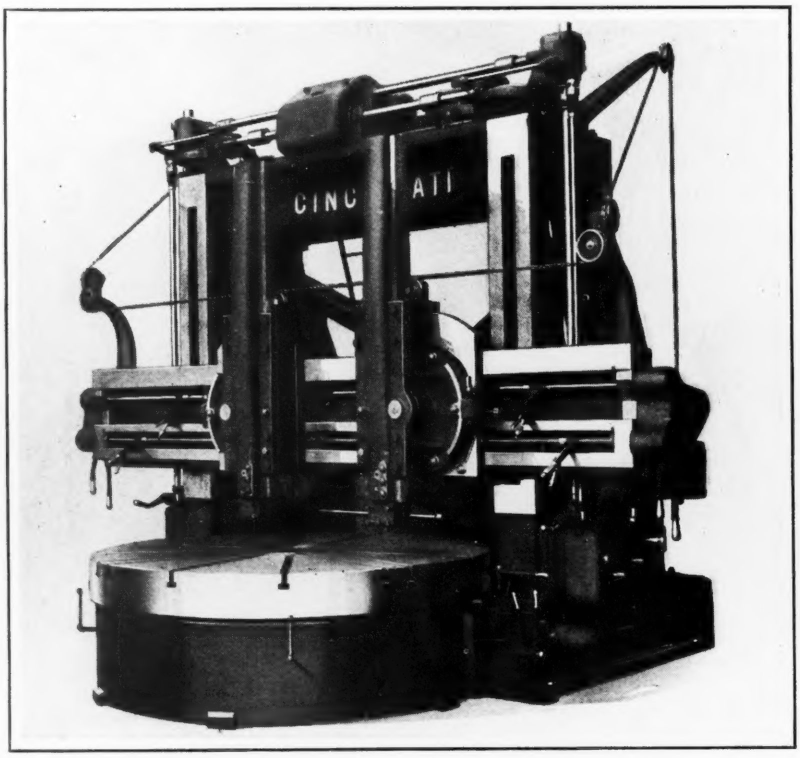


Fig. 1. Cincinnati Eight-foot "Hypro" Boring Mill

Grinding stock to the extent of 0.020 inch is left on the outside diameter of the bushings for fitting. These bushings are made of tool steel, and heat-treated to a file hardness, the diameter of the hole being held to limits of minus 0.000 inch and plus 0.0003 inch. The corner at the top of the hole is rounded to facilitate the entrance of the drill and permit its lubrication.

The other addition to the line consists of plain headless press-fit bushings similar in design to the plain bushings previously made for use with liners, except that a grinding allowance of 0.020 inch is left for fitting. These bushings are also made in the sizes mentioned, and in three lengths

CINCINNATI "HYPRO" BORING MILL

An eight-foot boring mill with several new features is being placed on the market by the Cincinnati Planer Co., Cincinnati, Ohio, under the name of "Hypro." Rapidity and convenience of operation, simplicity of design, elimination of wearing parts, and fool-proof arrangements that eliminate liability of breakage, have been especially considered in building this machine. There is a rapid power traverse to the side-heads, vertically and horizontally. By one movement of the operating lever the feeds are disengaged and the rapid power traverse imparted in the direction indicated by the movement of the lever. When the lever is brought back to a neutral position, the rapid power traverse is disengaged and the feed re-engaged. All constantly moving parts have been eliminated in this mechanism, with the exception of the motor and one shaft on top of the machine.

The rapid power traverse is employed to set the heads approximately in the desired positions, quick-adjustment handles are operated for the final close setting of the tools. With these handles, the heads can be moved accurately any number of thousandths of an inch without the operator going to the end of the rail. Graduated collars are provided on both feeding mechanisms for use in making these final adjustments. Feed changes for both heads are obtained through gear-boxes on which the feeds can be read directly in inches per revolution of the table. The rail is elevated and lowered through a mechanism that is interlocked with the rapid power traverse, and there is an automatic stop that controls the maximum height of the rail.

Changes in table speeds are obtained through the main gear-box, and are made from the operator's position at the front of the machine. To assist him in setting up work on the table, a start-and-stop lever is provided by means of which the table can be made to revolve any part of a revolution at the will of the operator. This lever functions through a clutch and brake on a high-speed shaft in the driving mechanism. When a boring mill is driven by an alternating-current motor, this feature is especially important. The speed gear-box is designed also to serve as a tie between the housing extensions, as shown in Fig. 2, and thus gives additional rigidity to the base of the machine. All driving gears in this box are made of steel, and all speed changes are obtained through positive clutches. The back-gear shaft extends through the front of the box, and has a third bearing in the bed proper, while the table pinion shaft extends from the bed and has a third bearing in the speed-box.

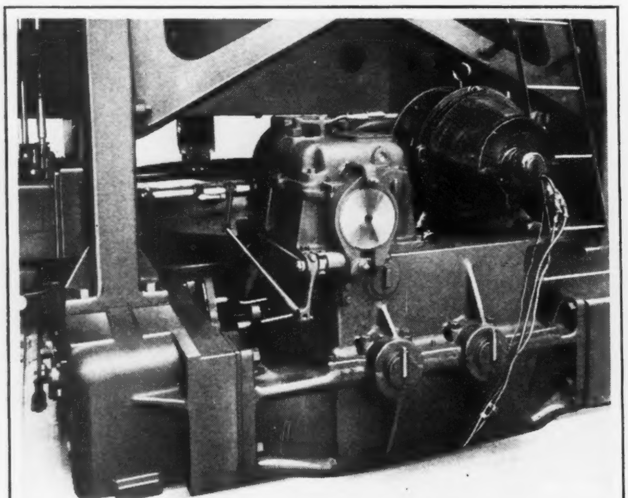


Fig. 2. Use of the Speed Gear-box as a Tie for the Housing Extensions

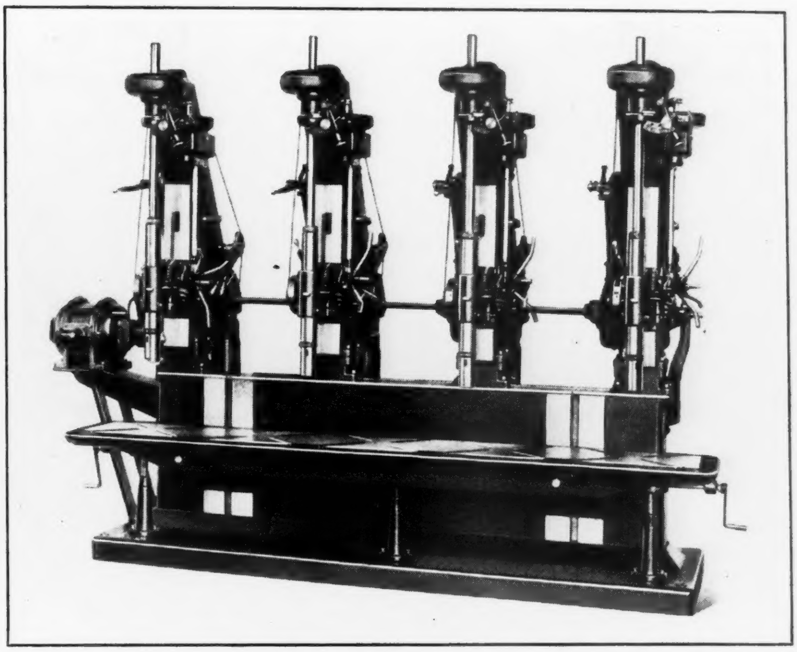
Fig. 3. View showing Construction of the Bed underneath the Table

The design of the bed is also a departure from the accepted standard. The table bearing has been located nearly under the normal position of the load, so as to lessen the tendency of the table to spring. Heavy radial ribs are provided, as shown in Fig. 3. A ground spindle is pressed into the table, and it runs in a bearing in the bed that is adjustable to compensate for wear. There are radial and parallel T-slots on the table for facilitating the set-up of work. The driving gear is located near the periphery of the table so as to drive the work close to the cutting tools. By the use of a bevel gear drive, it has been possible to support the driving pinion on both sides and to use automatic lubrication. The table pinion is made of chrome-nickel steel and heat-treated. The driving shaft has three bearings.

Wide-face heavy housings are used, which are mounted on large box extensions bolted to the bed and tied together at the back by the speed-box, as already mentioned. A box-type arch ties the housings together at the top, and additional rigidity is provided by the use of cross-braces to tie the housings together at the back. Centralized oil distributors deliver oil to all revolving bearings in both feed-boxes and in all the mechanism on top of the rail. These distributors require filling only once in about every ten days.

BARNES DRILL COMPANY'S GANG DRILLING MACHINE

A gang drilling machine with four sliding heads of the same design as the head of the No. 263 self-oiled, all-geared, all-ball-bearing, single-spindle drilling machine built by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., has been brought out by this concern. In April, 1924, MACHINERY was published a description of the single-spindle machine. One of the features of the gang machine is the adjustable head construction. The spindle next to the motor is fixed, and the other three have a lateral movement in relation to it. The center distance between adjacent spindles may be as small as 19 inches, and the distance between the two outside spindles, anything up to 96 inches. The three movable heads travel on top of the column. This machine can also be obtained with fixed spindles, placed 24 inches apart, and mounted either on a box column or on independent columns. In the latter case, square or round columns can be furnished.



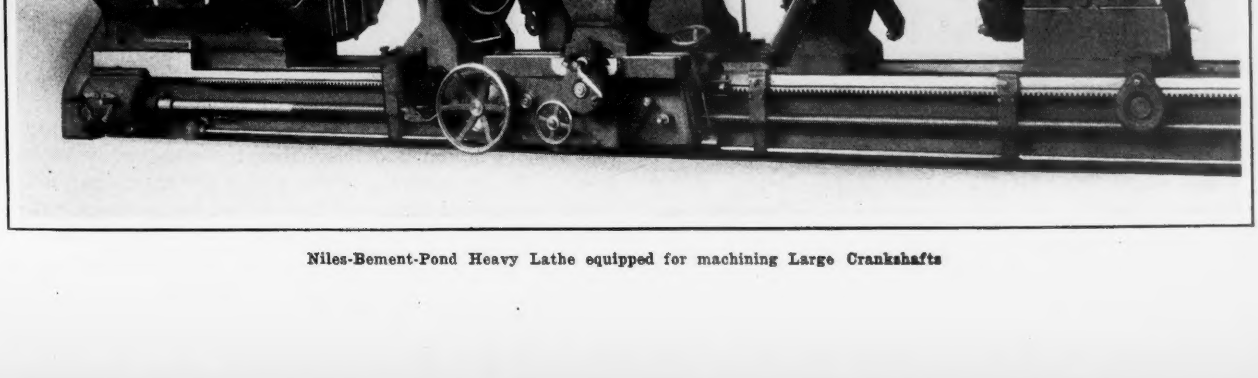
Gang Machine with One Fixed and Three Movable Drill Heads, built by the Barnes Drill Co.

Eight geared speed changes and eight geared feed changes, which are all independent of each other and under the instant control of the operator from the front of the machine, are available for each spindle. All sliding gears operate on six-spline shafts, radial ball bearings are furnished throughout, and a roller thrust bearing is supplied for the spindles. A driving clutch gear is used on each head, which is controlled by the lever on the upper left-hand side of the heads. This lever also controls the automatic reverse used in tapping operations.

NILES-BEMENT-POND CRANKSHAFT LATHE

A 48-inch heavy lathe designed with a view to reducing the time required for setting and machining large single- and multiple-throw crankshafts is being brought out by the Niles-Bement-Pond Co., 111 Broadway, New York City. This lathe is driven by an adjustable-speed motor mounted on a headstock that gives four mechanical changes of speed, which in combination with the speed range of the motor, provides a range of faceplate speeds that is ample for any work within the capacity of the machine. The machine may also be used for general lathe work.

Auxiliary faceplates are provided on the headstock and tailstock, and they have index-pins for alignment in setting up work in the lathe. Each faceplate is equipped with a



Niles-Bement-Pond Heavy Lathe equipped for machining Large Crankshafts

screw-adjusted slide, graduated to facilitate setting the slide to suit different distances between the centers of a shaft and its crankpins. Taper pins prevent movement of the slides after an adjustment has been made for a given crank. On each slide is fitted a clamping driver in which the end of the crankshaft is held, split bushings being used in the drivers to protect the shaft. The drivers may be rotated on the slides to permit angular adjustments to be made for multiple-throw crankshafts. Index-pins are used to locate the drivers, and they are locked to the slides by large clamping bolts.

The crankpin being turned is supported by a steadyrest secured to the crank cheek, which rotates in a bearing bored in accurate alignment with the spindles. There is also another steadyrest equipped with an offset ring that rotates in jaws; this is used in addition to the rotating steadyrest when turning multiple-throw crankshafts. It may be used with the ring or with the jaws only, as required for turning the pins or the journals.

On the front of the carriage is a three-position turret toolpost, and on the back of the carriage, a plain toolpost furnished with a laterally adjustable tool-slide. The plain toolpost is used for turning the ends of crank cheeks while the rough-turning is being done on the journals. A motor-driven pump on the back of the bed supplies coolant to the cutting tool. All the special attachments for crankshaft work can be quickly removed to permit the machine to be used for general lathe work.

BULLARD "VERT-AU-MATIC"

A single-spindle vertical chucking machine known as the "Vert-Au-Matic" is the latest addition to the line of automatic machines built by the Bullard Machine Tool Co., Bridgeport, Conn. This machine is practically one unit of the "Mult-Au-Matic," but it is not equipped with the coordinating control and indexing features which, of course, are unnecessary in a single-spindle machine. The "Vert-Au-Matic" is built at present in an 8-inch size, which receives work up to 6 inches in height and swings work up to 12 inches in diameter. Two larger sizes will also be built, a 12-inch size for work 6 inches high and swinging 16 inches in diameter, and a 16-inch size for work 6 inches high and swinging 21 inches in diameter.

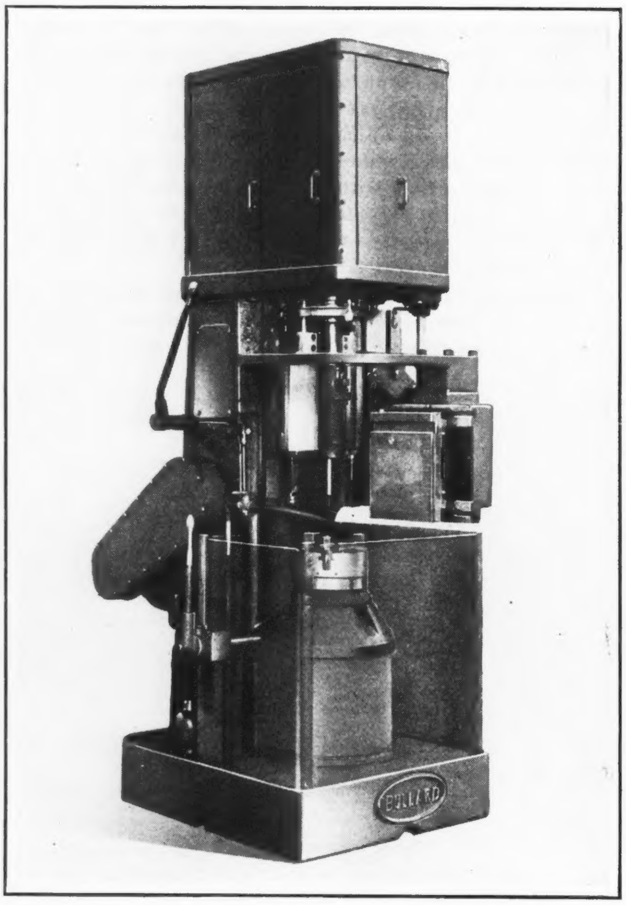


Fig. 1. Bullard Single-spindle Vertical Automatic Chucking Machine

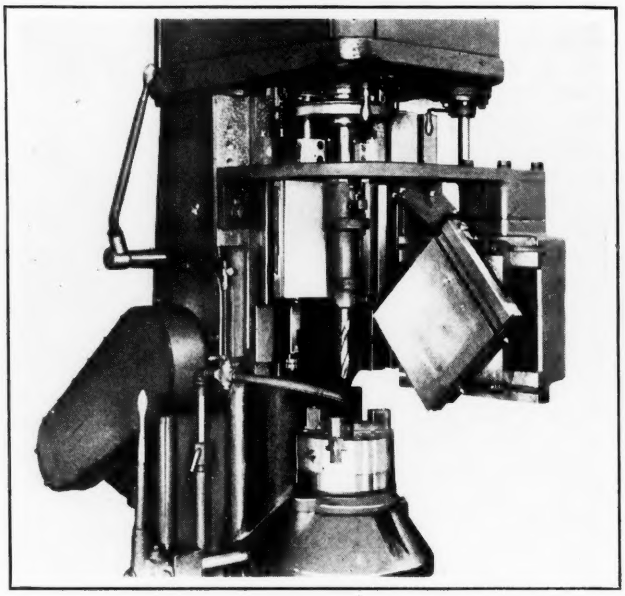


Fig. 2. Close-up View of the Main and Supplementary Side Tool-heads

The work-spindle is of the standard design used in the multiple-spindle models, with a self-centering conical thrust bearing under the spindle-head and two cylindrical bearings of large diameter and length that absorb side strain. The spindle is driven from the standard feed works located in the head of the machine, from which point spindle speeds are determined by change-gears that provide twenty-three changes ranging from 33 to 300 revolutions per minute. There are also twenty-three feed changes for the main head, from 0.0067 to 0.06 inch per revolution of the spindle.

The main tool-head is designed for vertical motion only, and has a full travel of 9 inches which, by limiting the machine to work 6 inches high, allows a clearance of 3 inches for chucking. The head may be equipped with a drill spindle, as shown in Fig. 2, for holding drills up to 1 1/4 inches in diameter. A feature of the machine is the use of a supplementary side-head like that used on the four-spindle "Mult-Au-Matic." This device includes a swivel and a tool-slide that can be fed 4 inches vertically, horizontally, or angularly. Within the device is a mechanism that provides rates of feed in direct relation to the feed of the main head. The ratio is determined by change-gears which are easily accessible.

A second feature consists of the power chucking device recently applied to the spindles of "Mult-Au-Matic" and "Contin-U-Matic" machines, for mechanically actuating the chuck jaws or holding fixtures. By simply throwing the chuck lever in either direction, the jaws are respectively closed or released by power. The time required for this operation is only two seconds. There is an adjustment for the tension of the jaws, so that work may be held without distortion from over-clamping.

The cycle of operations starts with placing a rough piece in the chuck and operating the chuck lever. Then, by tripping the clutch lever, power is applied to the spindle; the tool-heads advance rapidly to the point of cutting, feed through the cut, and return quickly; finally, the clutch is automatically disengaged. One operator can attend to as many machines as the time of the cycle permits.

A constant flood of oil is circulated from a reservoir in the base by a pump driven from the constant-speed main shaft. The oil is forced to the top of the machine, where it passes through a filter and then is fed by gravity to all enclosed operating units. The space required from spindle to

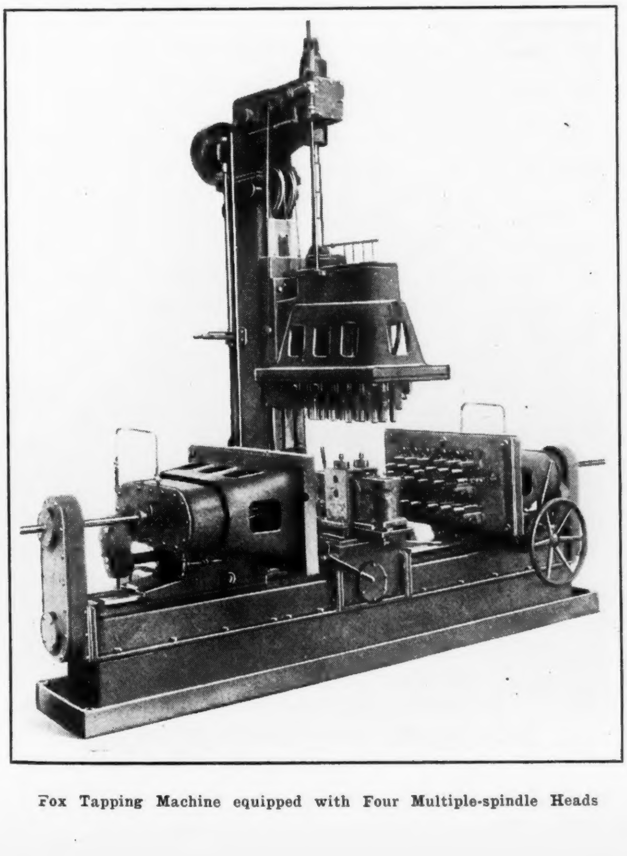
spindle of "Vert-Au-Matics" placed side by side, is less than four feet, and the necessary floor space for each machine is 45 by 50 inches. The machine is 8 1/2 feet high.

FOX FOUR-WAY MULTIPLE TAPPING MACHINE

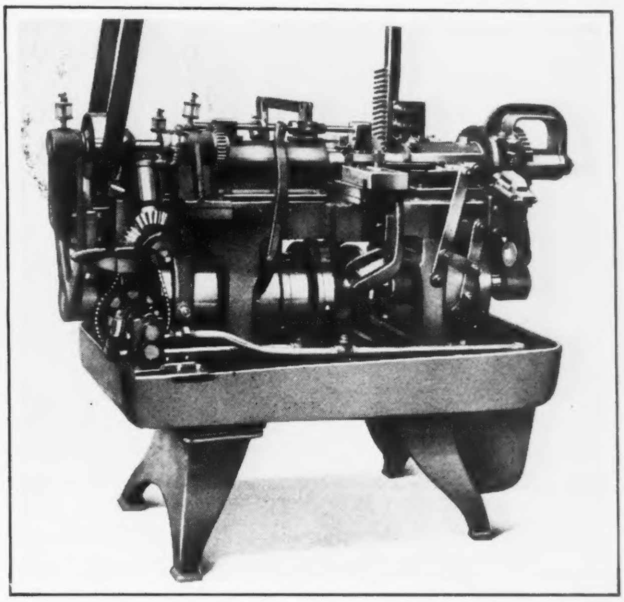
In April MACHINERY was published a description of a machine equipped with four multiple-spindle heads that was built by the Fox Machine Co., Jackson, Mich., for simultaneously drilling sixty-eight holes in an automobile cylinder block. The same concern has also built the four-head machine here illustrated for tapping the same sixty-eight holes at one time. The tapping time is fifteen seconds, and the floor-to-floor time is eighteen seconds.

After the work has been placed in position, one movement is imparted to the handle at the front of the machine to start all taps into the work. The taps are advanced by feed gearing carried on the head, which advances the heads at a speed corresponding to the lead of the taps. When the predetermined tapping depth is reached, the motion of the spindle is reversed and the heads are backed out at a speed again dependent upon the lead of the taps. At the completion of the return movement, the heads are automatically stopped. The reversing and stopping of the vertical head is controlled by the regular Fox tapping control which is installed on the head of the machine, while the three horizontal heads are operated by tapping controls located at the rear of the base. The tapping controls are so arranged that the operator can stop and reverse the heads at any point. Each head is independently adjustable, and each spindle on the three large heads has an in-and-out adjustment.

The spindles of the three horizontal heads are driven by a 15-horsepower motor, while those of the vertical head are driven by a 10-horsepower motor; the latter also drives a circulating pump which delivers oil to the bearings of all heads. The spindles of all heads, except the small auxiliary head, are of standard type, and are mounted on cluster plates. The auxiliary head is of the fixed-center type, owing to the restricted space in which it operates. The taps are carried by collets in floating holders, each collet being quickly removable for replacing taps. The weight of the machine, without the motor, is about 18,000 pounds.



Fox Tapping Machine equipped with Four Multiple-spindle Heads



Kent Automatic Machine for pointing and facing Cap-screws and Bolts

KENT CAP-SCREW POINTING AND FACING MACHINE

An automatic machine for pointing and facing cap-screws, bolts, etc., is being introduced to the trade by the Kent Machine Co., Kent, Ohio. The machine illustrated is belt-driven and equipped with a magazine feed, but it can also be built with a motor drive and a hopper feed. The pointing and facing processes are performed simultaneously on two different pieces of work. With a screw made from bar stock in an automatic screw machine, the under side of the head is shaved and the screw pointed, but with an upset screw both the top and under side of the head are shaved and the body pointed. The magazine holds from twenty to forty-five screws at one time, depending upon the size of the work. It is adjustable to accommodate different sizes of screws, as are also the pointing and shaving tools.

The screws are fed by gravity down the magazine slide, and are moved forward one at a time by a pusher-rod into a revolving work-holder. This work-holder has four split chucks or plugs, and is indexed one-quarter revolution at a time. The halves of the chucks are held together by bolts on which are mounted springs that tend to open the chucks slightly except when they are acted upon by a cam-controlled gripping mechanism. In the first work position, the screw is pointed by a standard adjustable roller box-tool which operates in a revolving spindle. The second position is an idle one. As the work-holder is indexed into the third position, a transfer head in which fingers are fastened, grasps the screw. Meanwhile, a pusher-rod advances to push the piece from the holder into a revolving chuck. When the transfer head and pusher-rod are drawn back, a forming slide is advanced over the work. This slide carries a special holder in which are mounted two circular forming tools that chamfer the top and face the under side of the head. Screws from 1/4 to 5/8 inch diameter, inclusive, and of any length from 3/4 to 4 inches, can be handled.

EX-CELL-O AIR-DRIVEN GRINDING SPINDLES

Two high-speed air-turbine driven grinding spindles, the smaller of which operates at a speed of 65,000 revolutions per minute, have been developed by the Ex-Cell-O Tool & Mfg. Co., 1469 E. Grand Blvd., Detroit, Mich. These grinding spindles find their principal application in grinding hobs, small holes, taps, threads, and worms. With the small spindle, which is illustrated in Fig. 1, the manufacturer is grinding holes as small as 3/32 inch on a production basis, using

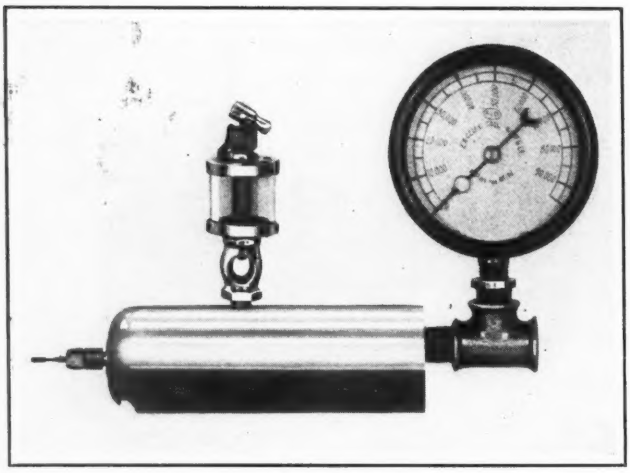


Fig. 1. Ex-Cell-O Air-driven Grinding Spindle which can be used at Speeds up to 65,000 Revolutions per Minute

steel-insert pencil wheels which may be obtained for use with the spindles. It is claimed that this grinding operation is performed in about one-tenth the time formerly spent in lapping the holes. The speed of 65,000 revolutions per minute is obtained with an air pressure of 80 to 90 pounds per square inch. In this work the air consumption is less than 10 cubic feet per minute.

Minute control over the speed developed is furnished by a throttle valve which governs the amount of air admitted to the spindle. A further refinement is a gage on the spindle which is calibrated to give the spindle speed directly in revolutions per minute. This enables the operator to have a definite knowledge of the spindle speed and to maintain the speed best suited for the work being done. The indicating gage is calibrated while the spindle is undergoing a test, by direct comparison with a speed-measuring device capable of determining speeds from 20,000 to 1,000,000 revolutions per minute, were it possible to obtain speeds as high as the last named.

The small spindle is very compact, being only 6 inches long and about 2 inches in diameter. The small air consumption is the result of the blade and nozzle design, the use of small and light parts, and the elimination of felt dust washers. The washers are unnecessary because of the unique disposition of the exhaust air, which is circulated about the working parts so as to cool the bearings of the spindle and finally exhaust it in such a way as to prevent the entrance of grinding dust into the bearings. The construction can be seen in Fig. 2.

This spindle is equipped with Ex-Cell-O high-speed ball bearings, which have the property of adjusting themselves at normal working speeds to the proper degree of tightness, due to centrifugal force causing the balls to climb toward the larger diameter of the conical outer races. This feature is claimed to eliminate all end play or radial "shake" when the spindle operates at normal speeds.

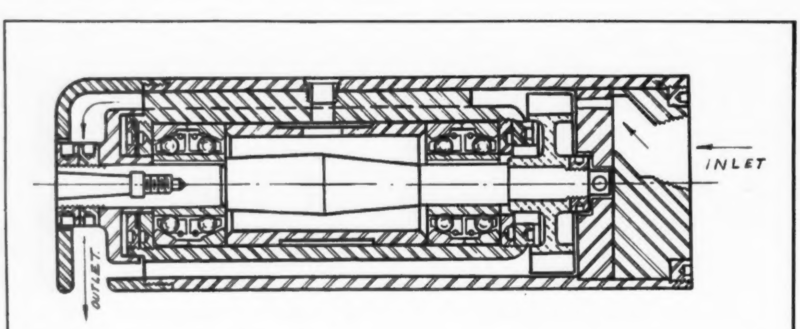


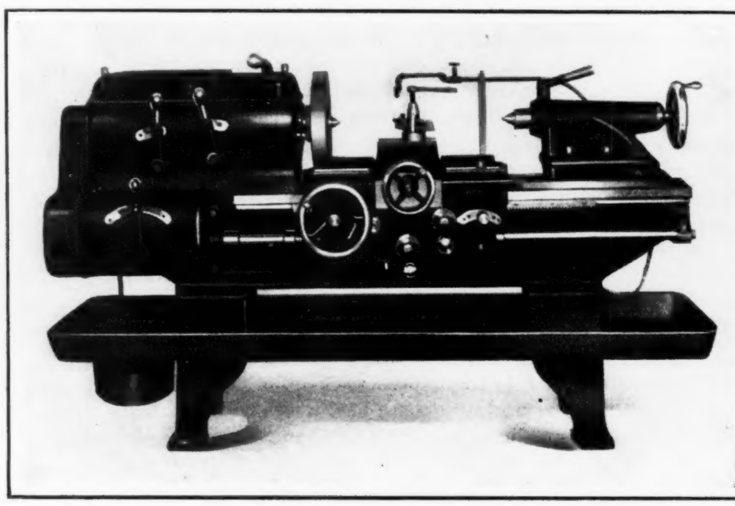
Fig. 2. Sectional View, showing the Construction of the Air-driven Grinding Spindle

The larger of the air spindles is designed to operate continuously at speeds up to 35,000 revolutions per minute. It is 2 1/2 inches in diameter and 8 inches long, and is adapted for grinding holes from 1/4 to 1/2 inch in diameter and for other classes of work to which pencil wheels may be applied. The design of this spindle is similar in all respects to that of the smaller spindle, and requires no further description. Applications have been made for patents to cover the design of both spindles.

The Ex-Cell-O Tool & Mfg. Co. has also just added a belt-driven extra heavy-duty type of spindle for use on Heald grinders, which is similar in design to a spindle described in October, 1924, MACHINERY. This spindle has a shaft diameter of 1 5/8 inches, and is of a two-body design with an outboard supporting bearing that absorbs part of the belt load and thus gives rigidity to the spindle.

MONARCH HELICAL-GEARED MANUFACTURING LATHES

Four-speed manufacturing lathes equipped with helical geared headstocks are now manufactured by the Monarch Machine Tool Co., 209 Oak St., Sidney, Ohio, in 16-inch heavy-duty, 18-inch standard, 18-inch extra heavy-duty, and 20-inch sizes. The 18-inch extra heavy-duty machine is shown in the illustration, equipped with a 6-foot bed. The arrangement of the gears in the headstock of these machines follows somewhat the design of the headstock on the lathe described in November, 1924, MACHINERY, but a smaller number of speeds is obtainable. All gears in the headstock have a helix angle of 16 degrees. Ball thrust bearings take up end thrusts developed by these gears and by the spindle. The intermediate shafts and the driving pulley are mounted in heavy double-row ball bearings. Adjustments of the spindle bearings enclosed in the headstock can be easily accomplished through a hand plate. The four mechanical changes of spindle speeds are obtained by manipulating two levers at the front of the headstock, which operate double jaw clutches that slide on square sections of the intermediate shafts and the spindle.

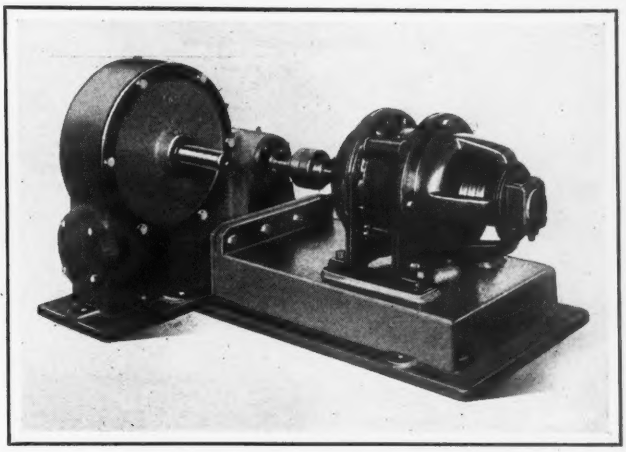


Monarch Manufacturing Lathe with Helical-geared Headstock

The driving clutch is a new multiple-disk type provided with a dual control, there being headstock and apron levers for starting, stopping, and braking the spindle. In disengaging the clutch by operating either of the levers, the brake is applied to stop the rotation of the spindle instantly. Changes in the spindle speed can be made quickly without "drifting" this clutch. The apron is a complete box-section casting which furnishes a double support for all shafts. The cross and longitudinal feeds of the apron and its slide are controlled through the

Monarch patented ball eccentric levers. The quick-change feed-box provides four different rates of feed.

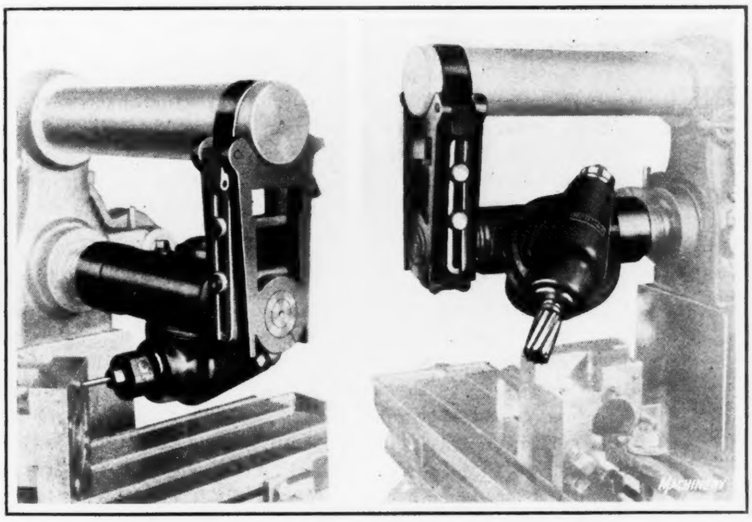
Multi-speed alternating-current motors and adjustable-speed direct-current motors can be used to obtain a larger range of spindle speeds than can be secured mechanically, should more speeds be desirable. The drive to the machine may be either through a silent chain or endless belt. The motor can be mounted on top of the headstock or on the rear of one leg, and on two of the machines it can be enclosed in the headstock leg. A single-pulley belt drive can also be furnished.



Foote Double Worm-gear Reduction Unit

PORTER-CABLE UNIVERSAL MILLING ATTACHMENT

An improved milling attachment, designated as model No. 5, has been added to the line of universal milling attachments made by the Porter-Cable Machine Co., Syracuse, N. Y. The new model is larger than the previous ones, and is capable of taking heavier cuts. It is adapted for irregular and intricate work requiring end-mills up to 1 1/2 inches in diameter. The attachment can be equipped with a head for boring fixtures and drill jigs at any desired angle. Several features of the design have been simplified; for example, there are fewer gears, the ratio being one to one, and the reversing mechanism has been eliminated.



Porter-Cable Heavy-duty Universal Milling Attachment

The attachment may be applied to any standard overhanging arm milling machine, and greatly increases the range and capacity of the machine due to the fact that the spindle can operate at any angle in any plane. The illustration shows the attachment in two different positions, the view at the right showing it arranged for milling, and the view at the left arranged for boring. The outer end of the frame is rigidly secured to the overhanging arm by a heavy adjustable clamp. A split draw-in collet for end-mills with 1/2-inch shanks is furnished. The attachment weighs 45 pounds, and can be put in place or removed in about three minutes.

FOOTE DOUBLE WORM-GEAR REDUCTION UNIT

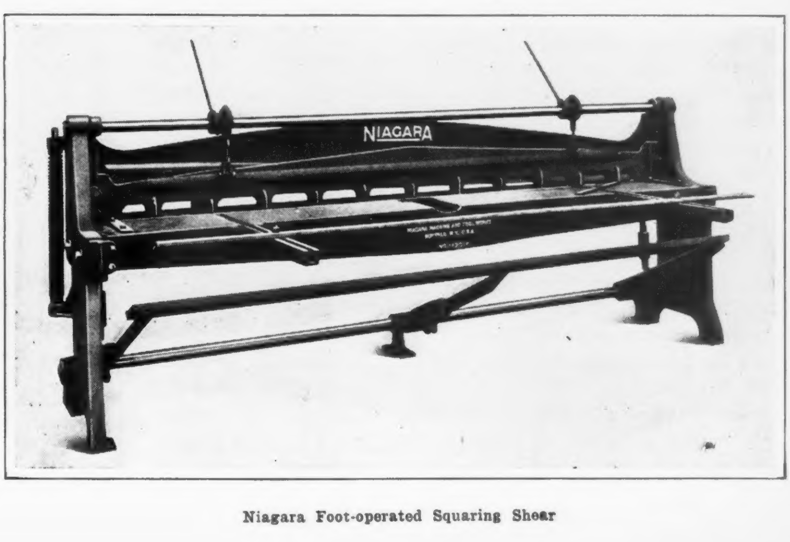
Reduction units with double sets of worm drives are built by the Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill., for giving reduction ratios as high as 10,000 to 1. The unit illustrated has a ratio of 3600 to 1, and is used for driving a conveyor. The motor is of the variable-speed induction type, and runs at different speeds from 1200 to 1800 revolutions per minute. When running at 1200 revolutions per minute, one horsepower is delivered into the unit and the delivery shaft of the unit runs only one-third of a revolution per minute. Motors of different capacities can be furnished.

The worm of the first drive is direct-connected to the motor by a Foote flexible coupling of the pin type, and drives a worm-gear on another shaft on which is keyed the worm of the second unit. This worm, in turn, drives the worm-gear of the second unit, the shaft of which serves as the driving shaft for the machinery or equipment with which the unit is used. The entire drive is enclosed in a cast-iron case to permit automatic lubrication. The worms are made of alloy steel, and the worm-gears of a special bronze.

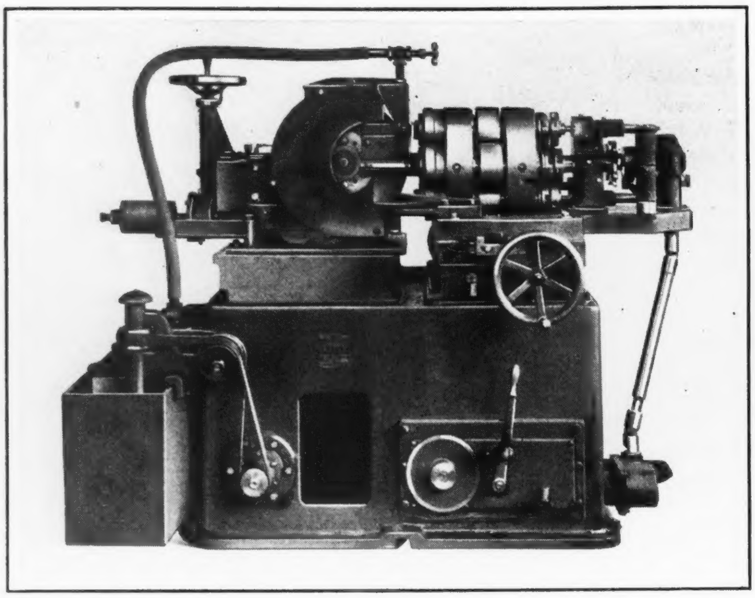
NIAGARA SQUARING SHEAR

A 10-foot squaring shear, operated by foot, is a recent addition to the line of sheet-metal working machines and tools built by the Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y. This shear, which is known as the No. 1120-F, has a capacity for cutting mild steel of 18 gage and lighter, and has a nominal cutting length of 120 inches. Considerable experimenting was done in designing this machine with a view to producing a shear that can be easily operated and that will combine accuracy with durability.

A firm grip on the metal is secured by a positive hold-down operated by two eccentrics, which is guided at each end by machined pads on the upper knife bar. The foot-treadle runs the entire length of the shear, and thus is readily accessible when cutting large sheets. Another feature of



Niagara Foot-operated Squaring Shear



Arter Automatic Tappet Grinding Machine

the machine is the provision of a patented parallel screw-adjustable back-gage, which can be adjusted from a standing position and from either end of the machine.

ARTER AUTOMATIC TAPPET GRINDING MACHINE

Both flat and crowned heads of tappets are ground true with the stem on a machine recently brought out by the Arter Grinding Machine Co., 72 Commercial St., Worcester, Mass. While designed primarily for grinding tappets, the machine may be adapted to other similar work. It is entirely automatic, with the exception of loading the work into the collets. The work is ground as it is traversed across the wheel, the latter being fed in at the same time.

One of the principal features of the machine is the action that controls the movement of the wheel-slide, the grinding stroke being produced by spring pressure, with a cam controlling the rate of movement. At the end of this stroke, the slide is freed from the influence of the cam for an adjustable interval, and the movement of the slide is arrested by a positive stop, so that the wheel grinds itself clear before the back stroke is begun. On the back stroke the cam drives direct. The wheel-head can be adjusted independently of the slide to compensate for wheel wear. Lubrication is provided continuously through sight drip-feed oilers by a pump from a reservoir in the wheel-head. The grinding spindle is oscillated in its bearings in order to assist the grinding action of the wheel and to insure good running-in of the bearings.

The upper part of the turret-slide is pivoted on its base so that it can be swung for grinding work at various angles to the face of the wheel. Reciprocation of the slide is accomplished through a connecting-rod operated by a cam. The four-station turret is indexed by a Geneva movement, a locking pawl dropping into a notch on the rim of the turret to insure positive positioning of the work-spindle at the grinding station. At the loading station, the work is placed in the open collet against a spring, with a latch holding the piece in position until the turret indexes. During the indexing movement, the work face rides along a guide and then across a positioning roll against which the work is held while the collet is automatically closed by a pull-rod that is cam-controlled.

As each work-spindle is indexed into the grinding station, the pulley mounted on the spindle is driven by coming in contact with a belt running between it and another pulley held against it by spring pressure. Four work-spindle speeds are available. The work is ejected at the fourth station by a rod which opens the collet and releases the ejecting spring. The movements of the wheel-slide, turret-slide, and turret indexing mechanism are tied together, as they are driven from one camshaft. It is possible to disengage a clutch at any time to stop the movement of all parts operated from the camshaft. A pump of the submerged centrifugal type supplies coolant to the grinding wheel.

"SUPER-STROM" BALL BEARINGS

A new line of "Super-Strom" radial ball bearings has been brought out by the Strom Ball Bearing Mfg. Co., 4563 Palmer St., Chicago, Ill., for use where increased load-carrying capacity is desired. They are made in light-, medium-, and heavy-duty types. The "Super-Strom" design of bearing has deep grooves and an increased number or size of balls, which is said to result in exceptional radial and thrust load carrying capacities. The nominal outside dimensions are the same as those of the international standard sizes, and so the bearings are interchangeable with standard bearings. Thus the bearings may be substituted in installations where the size has been determined by former use.

The retainers are of the wide-ribbon type, pressed from heavy stock to insure freedom from stress. They are accurately formed with spherical pockets for the steel balls, and the two halves of the retainer meet and are riveted together between each ball without intervening spacers. This design reduces the space between adjacent balls, and the rivets are located in the circumferential line of pressure of the ball against the pocket. The construction eliminates leverage tending to separate the plates or stretch the rivets.

LINCOLN WELDING MACHINES

A welding equipment especially designed for use in railroad shops has been brought out by the Lincoln Electric Co., Cleveland, Ohio. This welder is only 21 inches wide, so that it will easily pass through the narrowest alleys in a shop. The use of roller-bearing wheels makes it easily portable. The center of gravity of the equipment is located close to the floor so that the machine will not tip over. The frame is built of structural steel, and extends beyond the welding equipment so as to prevent backing the truck into anything that would damage the welder. The machine employs the stable arc, and is 300 amperes in size.

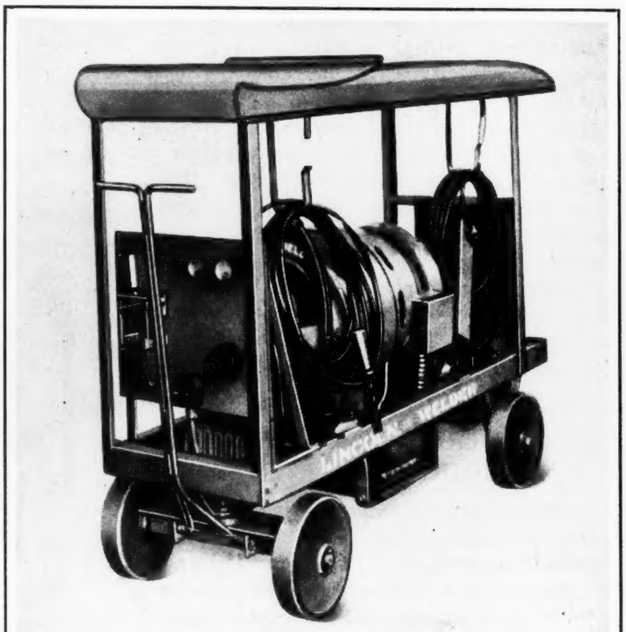


Fig. 1. Lincoln Portable Welder for Railroad Shop Use

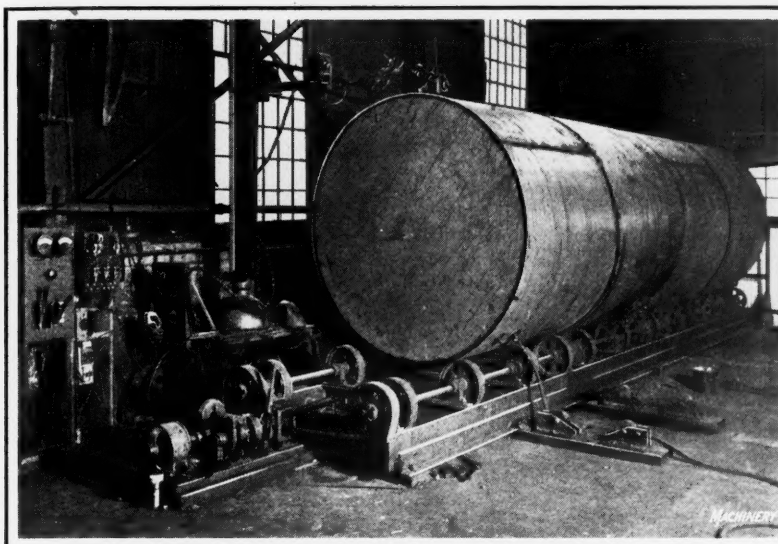


Fig. 2. Lincoln Automatic Welder for Storage Tanks

This equipment is built to take care of such jobs as the arc-welding of locomotive frames, cross-head guides, main driving wheels, journal boxes, and coupler shanks. It is claimed that from 4 to 5 feet of fire-box seam can be welded per hour.

Another recent development of the Lincoln Electric Co. is the automatic welder illustrated in Fig. 2 which has been built for use in the manufacture of storage tanks. It can be used for welding tanks of single- or multiple sections and of a wide range of sizes. Longitudinal seam welds are made by an automatic moving head attached to a single copper guide. After the seam welds have been made, the tank is laid on wheels and revolved under an automatic carbon head for making the girth welds.

BRIGHTMAN TURNING MACHINES

Improved machines for turning all grades of bar steel, alloy bars, tubing, and screw stock have been developed by the Brightman Bros. Co., 773 Markinson Ave., Columbus, O. The machines are built in three sizes for work from 1/2 to 2 inches in diameter, 1 to 4 inches in diameter, and 2 to 6 inches in diameter, respectively. The driving motor is mounted on top of the machines, and delivers power through a Link-Belt chain to the drive gear shaft, and through a system of change-gears to the main spindle. With a constant-speed motor, spindle speeds ranging from 45 to 345 revolutions per minute are obtainable. The feeds range from 1/16 to 3/8 inch per revolution of the main spindle. Reversal of the feeds is provided for, to aid in setting tools properly for the work.

An automatic gripping and feeding mechanism is arranged at each end of the machine. Relief has been provided for in this mechanism to take care of irregularities in hot-rolled stock. The main spindle is mounted in thrust bearings, and has an adjustment to compensate for wear. There is abundant chip and cutting lubricant space, the cutting lubricant being forced to the heads by a motor-driven pump unit which has a capacity for delivering 35 gallons per minute. The arrangement is such that the cutting lubricant floods the tools before the operation starts. Controls for the operation of the spindle and for adjusting the cutting heads are within convenient reach of the operator.

A crane is provided for lifting the cutting heads in and out of the machine. These heads can be arranged with one, two, or four tools for making light or heavy reductions in the diameter of work. The approximate floor space required for the 1- to 4-inch and 2- to 6-inch machines is 5 feet 6 inches by 16 feet.

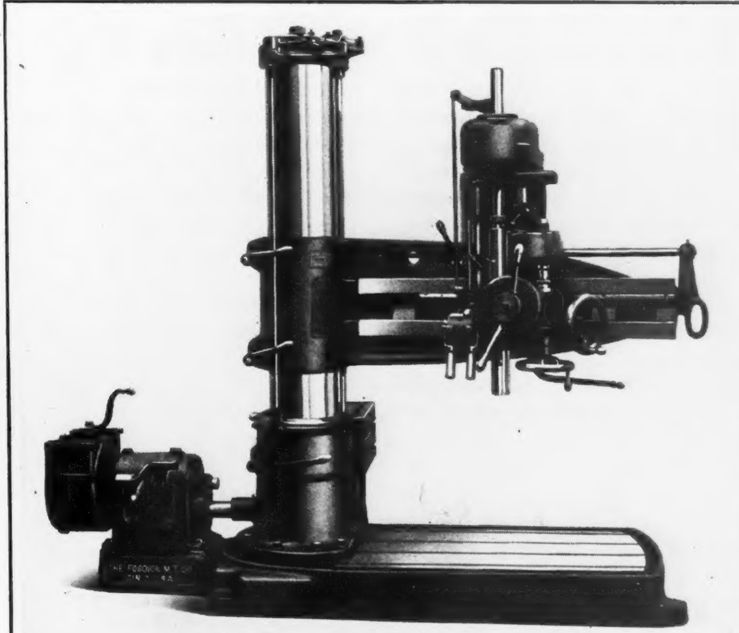
FOSDICK RADIAL DRILLING MACHINES

Heavy-duty radial drilling machines of improved design are being placed on the market by the Fosdick Machine Tool Co., Cincinnati, Ohio, in 4-, 5-, and 6-foot sizes. These machines can be furnished with three interchangeable drives—a belt drive through a speed-box; a constant-speed motor drive through a speed-box; and a variable-speed motor drive. The machines can also be arranged with a variable-speed motor drive on the arm, or a constant-speed motor drive through a speed-box, on the arm.

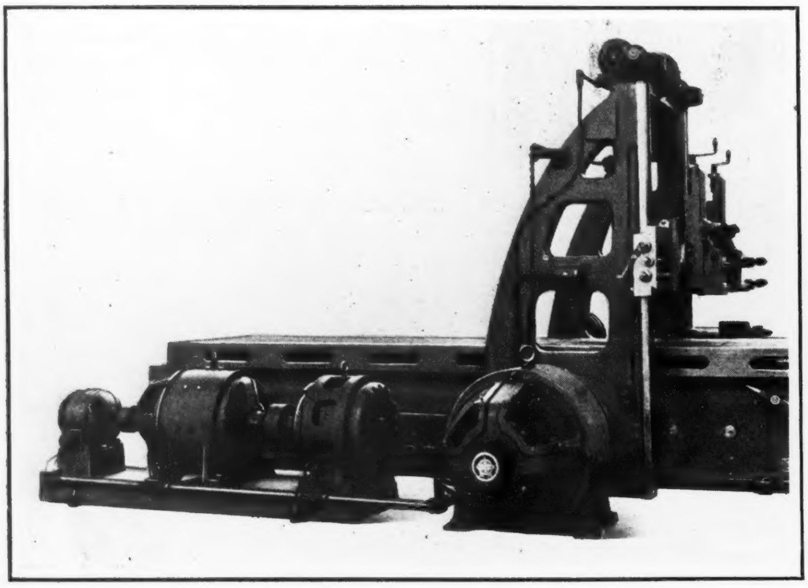
The column is accurately ground, and is of the tubular type, with a rigid inner column extending to the top where large annular and thrust ball bearings insure easy swinging of the arm. The clamping lever is located close to the column, so as not to interfere with work on the base when the arm is swung over the table. The arm is lowered at double the elevating speed; it is equipped with automatic trips that control the maximum up and down positions, and cannot be accidentally engaged.

The head is made lighter than the fully enclosed type, and is furnished with ball bearings to make it easy to operate. The handwheel for moving the head is placed at the right, so as to permit the operator to swing the arm and move the head simultaneously. At the same time the left hand is free to raise or lower the spindle. The tapping reverse friction clutches are of the multiple dry-disk type, and can be easily adjusted from the outside to take any required load. The spindle is made of a high-carbon crucible steel, and is driven by two long keys. An automatic trip and depth gage may be set to stop the spindle at any predetermined depth of drilling. The quick-return device is of the friction-clutch type, and may be operated through two levers.

All feed changes are made through one handle which is furnished with a direct-reading index dial. An overtake



Fosdick Radial Drilling Machine of Improved Design



Direct-current Planer Drive for Shops supplied with Alternating Current

clutch permits the hand feed to be used ahead of the power feed. The speed-box is of a simple design in which changes are made by operating one lever. Shocks are avoided by an arrangement that runs the machine at a reduced speed. A plain box table or a universal tilting table can be furnished for all machines.

BARRETT PORTABLE ELEVATORS

Hand and electrically operated portable elevators of a line recently developed by the Barrett-Cravens Co., 1328-34 W. Monroe St., Chicago, Ill., find numerous applications about the shop. For instance, they can be used in placing heavy work, dies, jigs, etc., in a machine; in raising motors to the ceiling for installation; and in stacking work in the stock-room. These elevators vary in height, platform dimensions, and capacity. All hand elevators may be operated at two speeds, one of which permits hoisting the platform quickly when empty, and the other, hoisting the platform at a slower rate when heavy material is being raised. The electric elevator uses current only when the load is being raised, and can also be operated by hand. The capacities range from 750 to 3000 pounds.

NILES-BEMENT-POND PLANER DRIVE

Planers in shops supplied with alternating-current electricity may be driven through a direct-current reversing motor by equipping the machine with the "Super" drive for planers that has recently been developed by the Niles-Bement-Pond Co., 111 Broadway, New York City. This drive comprises a direct-current adjustable-speed reversing motor which is connected directly to the planer, an alternating-current motor driven from the main line, and a generator driven by the alternating-current motor. This equipment may be placed at the rear of the machine, as shown in the illustration, but the motor-generator set can also be placed in any convenient location in the shop.

Control of the planer motor, with regard to both direction and speed, is obtained by manipulation of the small field current of the generator. A reversal of this field current changes the direction of the generated current and hence reverses the direction of the planer motor rotation. This reversal of the generator field is accomplished by means of an oscillating drum switch operated by dogs on the table, the contacts being closed and opened under oil in an enclosing case.

The changes in the speed of the planer motor are obtained by varying the field current of the generator as follows: A reduction of the field current lowers the voltage of the generated current and hence lowers the speed of the planer motor, while an increase in the field current raises the voltage and increases the motor speed. Variations in the field current for the cutting and return strokes are made through separate rheostats adjusted by hand. Cutting speeds of from 25 to 60 feet per minute, and return speeds as high as 160 feet per minute can be obtained. Arrangements can also be made for employing cutting speeds of less than 25 feet per minute.

Failure of the line voltage is likely to occur at any time from various causes, but if it fails, the generator will continue to run for a short time by its momentum, and will reverse the planer as usual until the whole system gradually comes to rest. The equipment includes a safety pendant switch, suspended from a swivel on the arch or cross-tie of the planer by a flexible cable, which enables the operator to keep the switch close at hand when working. Starting, stopping, reversing, or "jogging" of the table in fractions of an inch, can be effected by means of a single knob on this switch.

BROWN & SHARPE CUTTER CLEARANCE GAGE

A simple gage designed for use in grinding the correct clearance angle on milling cutters has been brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. This No. 900 gage may be used for right- and left-hand cutters and end-mills of all styles. The body is made V-shape in order to locate the gage on the cutter and hold the gage blade in the correct relation to the center line of the cutter. All contact surfaces are hardened and ground. Two gage blades are furnished with each gage, the diameters of the cutters for which they are intended to be used being stamped on each end. This gage may be used with all style cutters from 1/2 to 8 inches in diameter and of any width.

In use, the inside surfaces of the vee are brought into contact with the cutter as shown, and the blade is dropped upon the tooth being gaged. Then the cutter is revolved sufficiently to bring the face of the tooth into contact with the blade. The clearance angle on the tooth should correspond with the angle of the gage.

Brown & Sharpe Cutter-clearance Gage

AZOR BENCH GRINDER

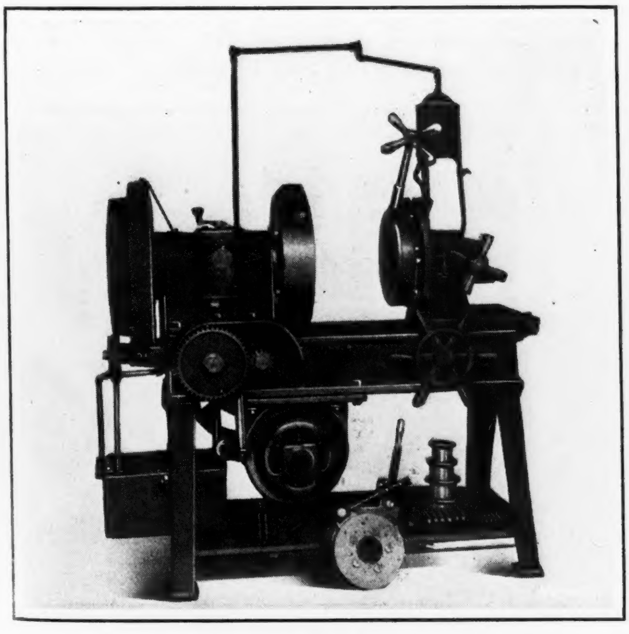
A motor-driven bench grinder being placed on the market by the Azor Motor Mfg. Co., 7424 Bessemer Ave., Cleveland, Ohio, is similar in appearance to the one described in November MACHINERY, but the construction has been completely redesigned. It is somewhat larger and is equipped with two 8- by 3/4-inch wheels, whereas the previous grinder was furnished with 6- by 3/4-inch wheels. The wheel-spindle is threaded to receive a Jacobs chuck. This new grinder is driven by a 1/3-horsepower motor running at 1800 revolutions per minute. It is 13 1/2 inches long, 11 inches high, and weighs 55 pounds.

SAUNDERS PIPE THREADING AND CUTTING MACHINE

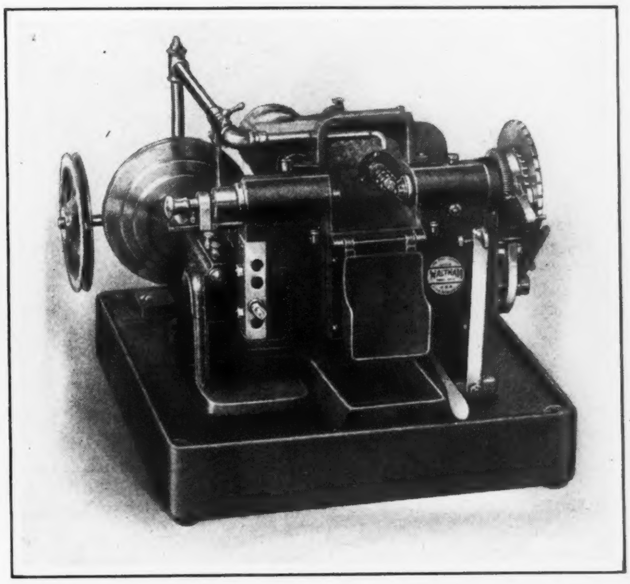
A self-contained pipe threading and cutting machine of improved design is being introduced to the trade by D. Saunders' Sons, Inc., Yonkers, N. Y. This No. 4-B machine has a capacity for 1/2- to 4-inch pipe, inclusive. It is driven by a three-horsepower constant-speed induction motor attached to the under side of the bed as illustrated, which results in a compact unit that is suitable both for all-around use as a portable machine and for permanent installation in one position. The motor is direct geared to the driving shaft of the machine, and is equipped with a drum-type controller for obtaining forward and reverse rotation. Different speeds are obtained by the use of change-gears.

The cutting-off head is arranged with a tool-slide and self-centering V-jaws that steady the pipe while it is being cut off. The carriage, together with the cutting-off head and die-slide, is moved by means of a rack-and-pinion mechanism actuated through a handwheel. The carriage is arranged with the die-head at the front sliding in ways, which allows the die-head to be brought close to the gripping chuck. When it is necessary to adjust the pipe for cutting off after it has been threaded, or for any other reason, the die-head is moved to one side, so that there is ample room for the pipe to pass through the cutting head without passing through the die-head. This provision reduces the likelihood of damage to the chasers. Two die-heads of an adjustable expanding type are furnished.

The gripping chuck for holding the pipe is of a standard universal type. At the rear of the spindle there is a two-jaw self-centering chuck, which is used to center the pipe in the machine. An automatic pump supplies a constant flow of oil to the chasers and the cutting-off tool.



Saunders Improved Pipe Treading and Cutting Machine



Waltham Automatic Machine for cutting Small Gears and Pinions

WALTHAM AUTOMATIC PINION CUTTING MACHINE

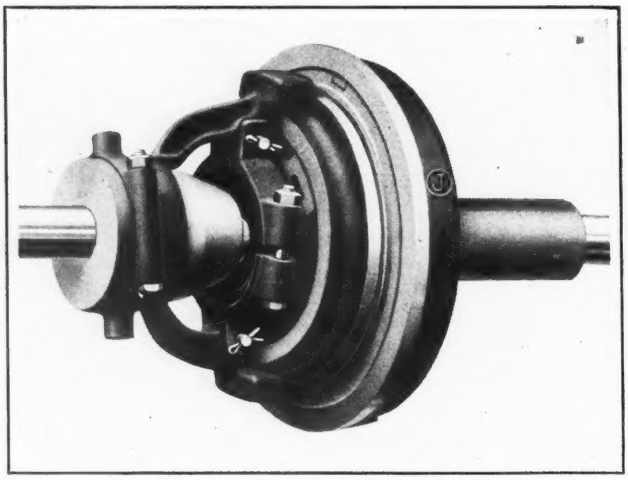
An automatic machine designed for cutting pinions and gears up to 1 1/2 inches pitch diameter and not coarser than 32 diametral pitch in steel, or 24 diametral pitch in soft brass, is a recent addition to the line of small machines built by the Waltham Machine Works, Newton St., Waltham, Mass. The machine is especially adapted to cutting watch, meter, and gage pinions, gears, and sectors. Standard cutters are 5/8 and 7/8 inch in diameter, 1/8 inch thick, and have a 1/4-inch hole. The cutter-spindle is carried by a swinging member which pivots around the shaft on which the driving pulley is located, this arrangement removing all belt strain from the spindle. The swinging member is automatically lifted on the return stroke of the work-slide so as to clear the work. On the swinging member is mounted a special stop-holding device which can be adjusted to place the cutter-spindle at approximately the right height for the diameter of the work to be cut. The exact position for the depth of cut is made by means of stop-screws.

The swinging member is mounted in a slide which can be adjusted at right angles to the centers of the work-holding spindles. On a single-cutter machine, this adjustment is obtained by means of a screw equipped with a graduated dial. With very fine teeth, small-diameter pinions and similar work, it is frequently necessary to take two or more cuts on each tooth, and to provide for this, two or three cutters are mounted on the cutter-arbor and so spaced that when one is taking the cut, the other two clear the work. In using three cutters, the machine functions automatically from the beginning of the first cut to the end of the third.

The work may be held in several ways; the headstock spindle is made to take a spring chuck, but a taper chuck can also be provided so that the work may be held on centers or in a taper socket. Provision is also made for holding an arbor containing a stack of gears. This arbor may be easily removed and replaced by a duplicate one. The base of the machine is 16 1/2 inches square, and the entire machine weighs about 195 pounds.

LEMLEY FRICTION CLUTCH

The Lemley model F friction clutch, manufactured by the W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill., is a medium and light-duty clutch that can be applied to practically any machine or countershaft requiring a friction clutch. It has few parts, all of which are in plain view and readily accessible. No special tools are required to adjust or disassemble the clutch, and the principle of

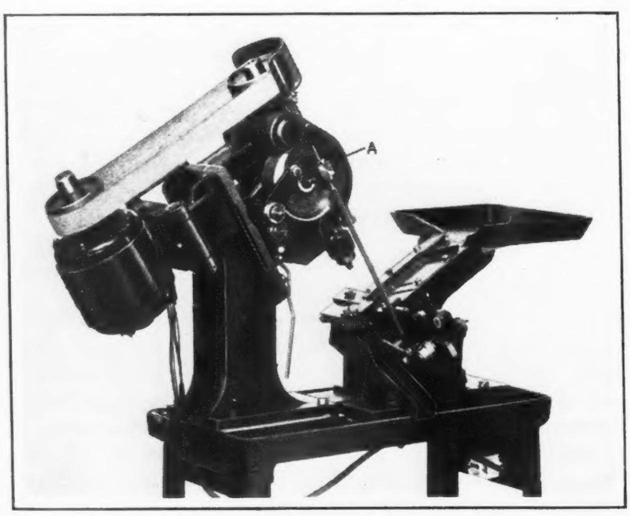


Lemley Friction Clutch manufactured by the W. A. Jones Foundry & Machine Co.

operation is simple. The design is such as to insure uniform pressure on the friction surfaces at all times. The two toggles are adjusted at the same time by means of one split ring nut. Free-floating friction rings of fiber or asbestos brake lining material, are used. This type of clutch may be furnished as a sleeve clutch or a cut-off coupling. It may be bolted to the arms of pulleys, sprockets, gears, sheaves, etc.

KINGSBURY AUTOMATIC BURRING MACHINE

A chute-feed machine especially designed for countersinking the rear end of the hole in parts such as are produced in automatic screw machines, in order to remove the burr



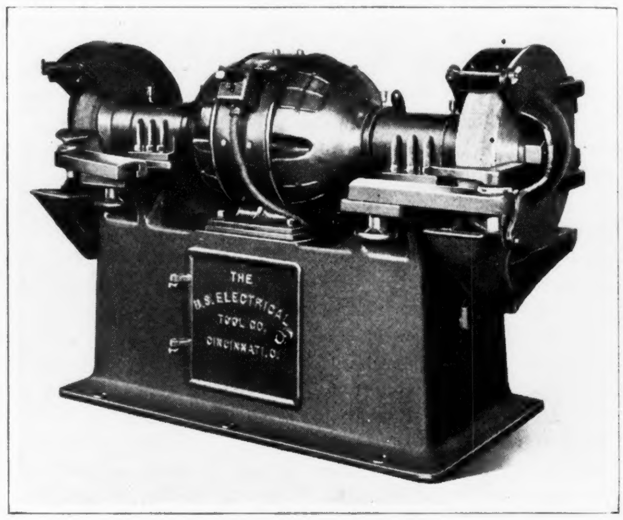
Kingsbury Automatic Burring Machine

left by the cutting-off tool, is a recent product of the Kingsbury Mfg. Co., Keene, N. H. On this work, the actual time for the operation is slight, and the production depends on the rapidity with which the operator can feed the work into the chuck from the pan. The work is taken from the bottom of the chute and pressed against a gage-block by a reciprocating link attached to toggle levers. The toggle levers straighten out in their final movement, exerting sufficient pressure on the work to hold it against rotation during the burring operation. When the link draws back to get a fresh blank, the finished piece drops out of the fixture.

The forward movement of the link is under pressure, but is controlled by cam *A* on the drill head. With this arrangement, if excessive resistance is met, as might happen if a piece were fed wrong, the machine would stop without subjecting the mechanism to excessive strain. The fixture is so designed that it can be used for various drilling and tapping operations in which the work can be readily fed from the chute. The standard Kingsbury automatic sensitive drill head is used on this machine. It is mounted at a 60-degree angle, so that the work can be fed in a 30-degree plane.

UNITED STATES ELECTRIC GRINDER

A new electric grinder has recently been developed by the United States Electrical Tool Co., Cincinnati, Ohio, which is so designed as to give a constant peripheral wheel speed, no matter what the wheel diameter is. The speed of the motor is automatically controlled by the wheel guards. When, as the wheel wears, the guards are moved back to gain access to the face of the wheel, the motor speed is automatically increased. The advantages claimed for this design are increased production and decreased wheel cost. The guards

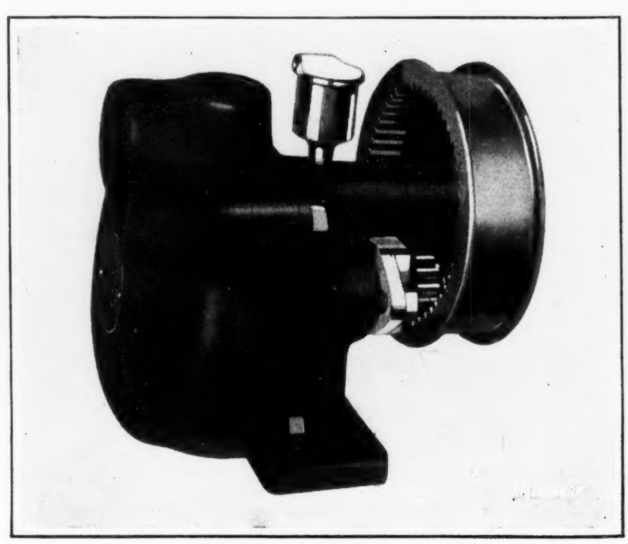


United States Electric Grinder designed to give a Constant Peripheral Wheel Speed

are of the hinged-door type, which makes the wheel readily accessible. The motor is of the totally enclosed type, equipped with a push-button control. The wheel-spindle is a heavy one-piece nickel steel shaft, mounted in four heavy-duty S K F ball bearings.

ROSS PUMP FOR REVERSING MACHINES

An improved gear-driven centrifugal pump which reverses automatically is made by the Ross Mfg. Co., Cleveland, Ohio, for installation on machines driven from countershafts that change their direction of rotation. The pump is equipped with a 4-inch pulley which may be driven at from 300 to



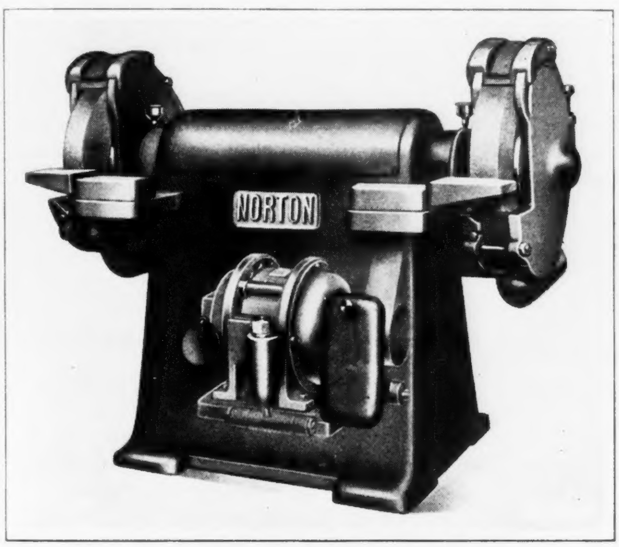
Ross Two-way Centrifugal Pump

600 revolutions per minute. There are four vanes on the impeller, and this part is actuated by a gear located outside of the liquid, which meshes with teeth cut on the internal rim of the pulley as illustrated. The impeller shaft bearing is of the gland type so as to seal the pump chamber. The packing of this bearing may be compressed by tightening two screws. Both bearings are bronze and are lubricated through one oil-cup.

As the inlet port is located at the top of the pump, the impeller is constantly submerged, which eliminates the necessity of priming. The manufacturer claims that chips and grit cannot clog the pump, so no strainer is used with it. Control of the amount of flow is accomplished by turning the regular valve on the outlet pipe. The pump is adaptable to side, top, or bottom suspension.

NORTON MOTOR-DRIVEN FLOOR STAND GRINDER

The "motor-in-the-base" grinding wheel stand here illustrated has recently been placed on the market by the Norton Co., Worcester, Mass. This machine is built in 16-, 20-, and 24-inch sizes, and is a self-contained unit suitable for heavy-duty work. The motor is mounted in the base on a pivoted



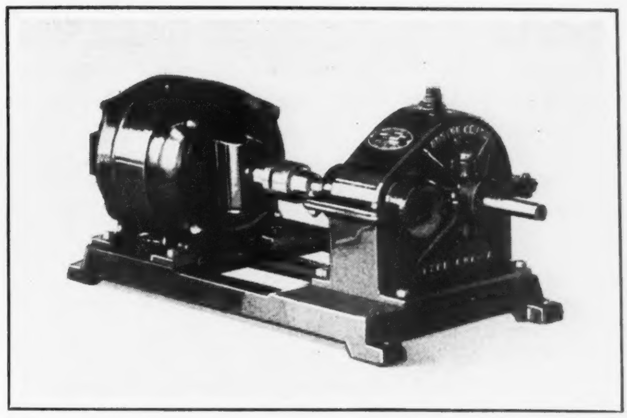
Norton Motor-in-the-base Grinding Wheel Floor Stand

platform, which permits an adjustment for belt tension. In this location, the motor is protected from dust, and there is sufficient space for any standard motor of the proper size and speed. With this arrangement, long delays due to motor trouble are obviated, as the defective motor can be removed and another one installed in a few minutes.

The wheel-spindle is rugged and runs in roller bearings that can be adjusted for wear. Two pulleys mounted on the spindle provide the proper surface speed for full-size and smaller wheels. The combination protection and dust hoods are of an improved design. They are made strong enough to hold the fragments of a broken wheel, and are provided with a cover that is hinged to facilitate wheel changes. The work-rests are large, and have a chilled finished surface. They can be easily removed to permit the grinding of large pieces or adjustment for wheel wear.

BOSTON SPEED-REDUCTION UNIT

In the accompanying illustration is shown a type GUH-A speed-reduction unit recently brought out by the Boston Gear Works Sales Co., Norfolk Downs (Quincy), Mass., to meet the need for drives of small horsepower. The unit is mounted on a cast-iron base, together with a 1/4-horsepower alternating-current motor, running at 1725 revolutions per minute. This assembly offers a convenient power transmis-



Boston Speed-reduction Unit for Small Horsepower Drives

sion unit that can be used in a large variety of applications. The connection between the motor and the speed-reduction unit is made by means of a Boston flexible insulated coupling, which is constructed on the principle of a three-jaw clutch, each jaw having a non-metallic cushion to absorb backlash and give noiseless operation. A similar reduction unit can be supplied in combination with a one-horsepower motor running at 1800 revolutions per minute. The regular sizes of reduction units are equipped with herringbone gears, but for reducing from a driving speed of less than 1000 revolutions per minute, spur gears can be furnished. The gears and bearings are lubricated from an oil reservoir.

LEITZ "BINOCULAR STEREO MAGNIFIER"

A magnifier intended for use in the visual inspection of parts has recently been placed on the market by E. Leitz, Inc., 60 E. 10th St., New York City, under the trade name of "Binocular Stereo Magnifier." This magnifier produces a stereoscopic image, which shows the object under examination in plastic relief, sharper and clearer than can be seen by the naked eye. Hence eyestrain resulting from a continuous inspection of parts is obviated by the use of the device.

The magnifier resembles a pair of prism binoculars arranged on a stand. Each tube is rotated on its axis to adjust the interpupillary distance of the observer's eyes. The prism bodies are equipped with eye-pieces which slide in tubular mounts to allow a correction to suit differences of vision between eyes of the observer. The device permits a magnification of from 3.5 to 30 diameters. Changes of magnification are accomplished by simply interchanging the eye-pieces of the magnifier, which can readily be done without dismantling the apparatus and without losing much time. The working distance from the prism body to the specimen

Leitz "Binocular Stereo Magnifier" for Inspection Purposes

varies up to 6 inches, and is dependent upon the magnification. Large specimens can be viewed in section. Interchangeable stands can be furnished to permit one binocular body to be used at different machines or benches.

MAHANITE BEARINGS

A new bearing material known as "Mahanite" is being manufactured by J. E. Loudon & Co., P. O. Box 240, Boston 10, Mass. It is a special slow-wearing alloy, produced as the result of experience gained in making various tests on different bearing materials. "Mahanite" is sold in the form of solid bars and bushings. The bars are regularly 24 inches in length by 1/2 to 1 1/4 inches in diameter and special sizes are made to specifications. Bushings made solid of "Mahanite" or lined with it are made in all sizes, either finished or unfinished. The sleeves of the lined bushings are gray iron castings.

BENCH ROD-CUTTER

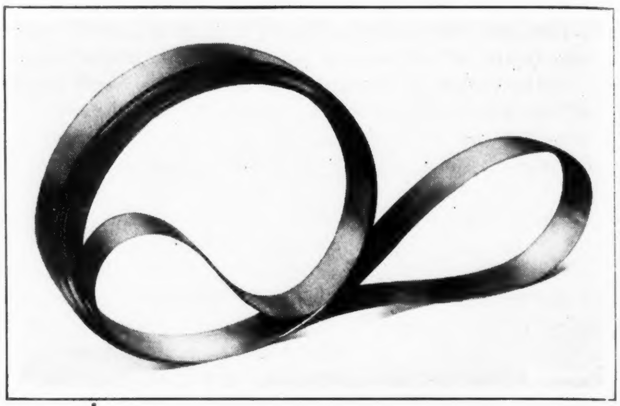
The Bench Machine Tool Co., 220 N. 13th St., Philadelphia, Pa., has recently developed an addition to its line of rod-cutters. This device, which is known as the "Bench rod-cutter No. 2" cuts round rods of any metal from 3/8 to 3/4 inch in diameter. It is hand-operated, and is arranged to be mounted on a bench. The cutter is rapid in operation, since all that is necessary is to push in the stock and pull the handle. A lever and cam action make it easily operated even in continuous use on 3/4-inch steel.

Bench Hand-operated Rod-cutter

The cutting dies are made of a special alloy tool steel, hardened and ground, and all studs are made of alloy steel. The cutting action is simple shearing, but the rod is so confined that practically no deformation takes place. The cut ends are left clean and square, so that the work is ready for threading and similar operations. A gage provides for cutting work to exact length.

DEFIANCE BORING, MILLING, DRILLING AND TAPPING MACHINE

A special No. 6 horizontal boring, milling, drilling and tapping machine has recently been designed and built by the Defiance Machine Works, Defiance, Ohio, to cover a larger range of work than the standard No. 6 machine that has been previously described in the technical press. This machine embodies all the special features of the Defiance horizontal milling machines. Some of the specifications of the new size are as follows: Travel of spindle, 60 inches; length of bed, 10 feet; maximum distance from face of spindle sleeve to face of tailstock, 9 feet 6 inches; maximum distance from center of spindle to top of platen, 60 inches; maximum distance from center of spindle to top of bed, 70 1/2 inches; vertical adjustment of spindle head, 60 inches; working surface of platen, 36 by 64 inches; cross-feed of platen, 64 inches; and weight of machine, 30,000 pounds.



"Endural" Endless Steel Belt for Power Transmission Drives and Conveyors

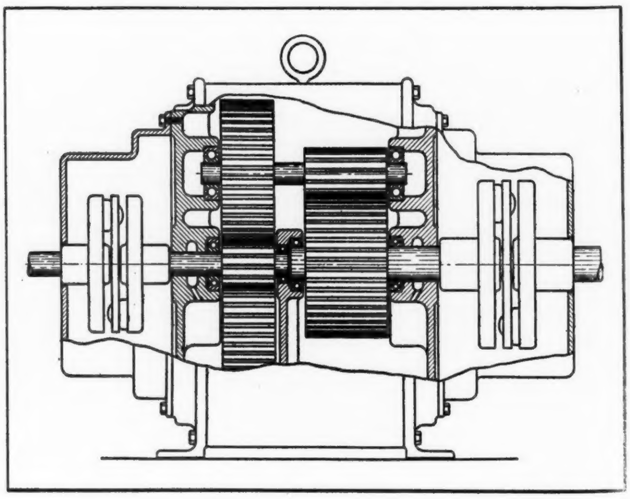
"ENDURAL" ENDLESS STEEL BELTS

Endless steel belts for transmitting power to machines, conveyors, etc., have been placed on the market by the Power Engineering Co., 535 W. Rayen Ave., Youngstown, Ohio, under the trade name of "Endural". These belts are manufactured from alloy steels that are rustless and stainless, and are said not to be affected by high or low temperatures, or by oil, moisture, acids or changing atmospheric conditions. They are made to order for specified applications in sizes ranging from 6 to 100 feet in length, and from 1 to 6 inches in width, for operation over pulleys 6 inches in diameter and larger. They are also made in certain standard lengths and widths for general applications over pulleys 8 inches in diameter and larger. The standard lengths are 14, 16, 18, 20, 22, and 24 feet, and the standard widths 1 1/2, 2, 2 1/2, 3, and 4 inches. The normal capacity for the standard sizes is approximately 8 horsepower per inch of width.

ALBAUGH-DOVER SPUR GEAR REDUCER

A new spur gear speed reducer has been brought out by the Albaugh-Dover Mfg. Co., 2147 Marshall Blvd., Chicago, Ill. This speed reducer is usually arranged with three intermediate shafts uniformly spaced about the center line of the driving shaft. These intermediate shafts carry the speed-changing gears that operate between the driving and the driven shafts. They extend entirely across the reducer housing, and are journaled in the end walls of the casing. All shafts are mounted in ball bearings, and the housing is oil-tight, the mechanism being entirely enclosed, as shown in the illustration.

Extreme reduction is attained in the transmission by the provision of an internal gear that meshes with pinions mounted on the projected ends of the intermediate shafts outside the main housing. The internal gear, together with

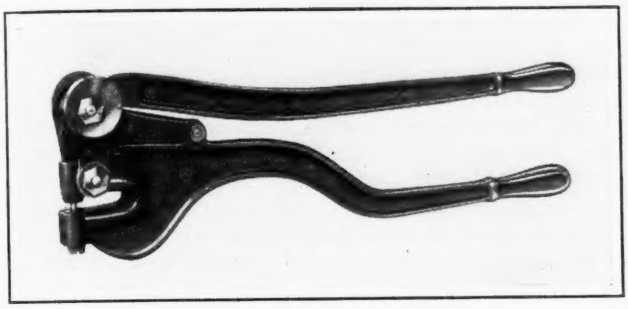


Albaugh-Dover Spur Gear Speed Reducer

the couplings connected to the driving and the driven ends of the shafts, is enclosed by attached housing extensions, which serve as safety covers and protect the gears and bearings from dust. Any ratio of speed change may be effected within the limits of the gear ratios. These reducers may be run clockwise or counter-clockwise, either continuously or alternately.

"IMPERIAL" HAND-OPERATED PUNCH

A hand-operated punch which may be used for punching holes up to 1/4 inch in diameter through sheet iron 1/4 inch thick has been placed on the market by the Whitney Metal Tool Co., Rockford, Ill. This device can be operated within a 90-degree movement of the handles, which is a feature of advantage when working in close quarters. It is equipped



"Imperial" Roller-bearing Hand-operated Punch

with roller bearings to offset friction and make the operation easy. The parts are heat-treated drop-forgings. The throat depth is 2 1/8 inches; the length over all, 25 1/2 inches; and the weight, 16 pounds.

GENERAL ELECTRIC ARC WELDERS

Automatic arc welding equipments for a variety of jobs are now built by the General Electric Co., Schenectady, N. Y., furnished with the automatic welding carriage described in January MACHINERY. These equipments find their principal application in the construction of such standard products as tanks, boilers, cans, axle housings, and pipe. Other uses are found in the repair of under-cut shafts or axles, and in building up sharp flanges on car wheels and worn locomotive guide rods. A push-button control on these equipments provides ease of operation. The complete outfit consists of an automatic welding head and control panel, travel carriage, and clamping device.

* * *

DROP-FORGING DURALUMIN

In a paper prepared by H. A. Whiteley, which was awarded the first prize in the Clarke Memorial Competition (in Great Britain), it is stated that duralumin may be drop-forged in the same dies as are used for steel. Although the coefficient of expansion of aluminum is twice that of steel, the forging temperature is only one-half, so that dies with a shrinkage allowance for steel are suitable for duralumin. Nevertheless, it is true that the best results are obtained by modifying the design of the drop-forging to suit duralumin, bearing in mind that duralumin does not flow quite so readily as steel. Owing to the sluggish flow, the dies must also be very smooth. The correct forging temperature is about 900 degrees F. If heated above 930 degrees F., duralumin becomes crumbly, and when drop-forged is likely to disintegrate. The correct forging temperature range, therefore, is important, but may vary from 880 to 920 degrees F.

* * *

In 1924, the railroads consumed 15 per cent of the forest products of the United States, spending $125,000,000 for cross-ties alone.

EFFECT OF LOANS TO GERMANY ON AMERICAN INDUSTRIES

In a paper presented by O. B. Iles, president of the National Machine Tool Builders' Association and president of the International Machine Tool Co., Indianapolis, Ind., before the annual meeting of the Bankers' Association for Foreign Trade, at Cincinnati, early in April, Mr. Iles pointed out that during 1924 nearly $900,000,000 of new capital loans were made by bankers in the United States to foreign governments and to industrial corporations abroad. In addition to this, it has been reported that $300,000,000 not included in these figures was loaned to foreign industrial corporations. The speaker pointed out that apparently no thought has been given by the bankers of the United States, in making these loans, to their effect upon the industrial interests of the United States. Said Mr. Iles:

"England, Germany, Belgium, France, Holland, and other nations, which in the past have grown to be largely industrial, have had colonies upon which they depended for an outlet for the products of their manufacturing institutions. They have jealously guarded the interests of these manufacturing institutions within their borders, knowing full well that their general prosperity depended upon the prosperity of these institutions.

"Due to their form of government, the commercial and business interests of these other nations were able to enlist the active cooperation of all of their diplomatic representatives and commercial attachés, not only in the colonies, but also in all other countries. They have also had the cooperation of their bankers in furthering the interest of their industries and manufacturers. When a railroad is built in China or Chile or India, and English or German capital is used to finance this railroad, there is a clause in the agreement, making it necessary to spend the money for the material, machinery, and equipment in England or Germany, according to the source of the financial assistance. These orders for machinery and equipment come to the manufacturers of the country furnishing the money.

"If the United States furnishes either the industries of Germany or the banks of Germany, who, in turn, furnish the industries with the capital necessary to carry on competition, it is certain that the United States manufacturers of machinery and equipment and other products will suffer.

"I think that there is an opportunity under the present conditions for the bankers of the United States to be of real constructive service to the manufacturers of machinery and equipment in the United States. When money is furnished to build and equip a railroad, thought should be given to the welfare of the manufacturers of railroad equipment and machine tools in the United States. A clause should be inserted in the contract that this equipment be bought in the United States if possible, to give the manufacturers in the United States a chance at this business."

* * *

Although platinum is one of the most rare metals, occurring in workable quantities in but few widely scattered locations, it is of great industrial importance and is practically indispensable in the chemical industry and in some of the industrial arts. Outside of the platinum group of metals—palladium, iridium, osmium, ruthenium and rhodium, with which it frequently occurs in natural combination—no satisfactory substitute has been found. The United States consumes more platinum than all other countries combined. By far the greater amount is used in jewelry. Annual requirements for this purpose increased from 82,000 ounces in 1919 to 106,000 ounces in 1923. Of the 152,000 ounces consumed in this country for all purposes in 1923, jewelry manufacturers used 69 per cent, the electrical industry 12 per cent, the dental industry 11 per cent, the chemical industry 6 per cent, and all others 2 per cent. In addition to pure platinum used by these industries in that year, more than 38,000 ounces of palladium, iridium and other platiniferous metals were used.—*Commerce Monthly*

The British Metal-working Industries

From Machinery's Special Correspondent

London, April 14

ALTHOUGH during February business in the metal-working industries was somewhat disappointing, the month of March saw a decided tendency to make up lost ground. The engineering fields generally continue to pursue a somewhat checkered course, but the bright spots are becoming more numerous.

The Machine Tool Industry

Machine tool makers in several areas are finding at the moment that there is greater activity in overseas markets than at home. In the Midlands, there is a strong demand for small turret lathes, and in many cases the machines are supplied ready tooled for the production of small brass or steel pieces. Three-operation automatics are also in demand. Considerable new equipment is still being purchased by automobile factories in this area, and plain grinding machines, single- and multiple-spindle drilling machines, turret lathes, and the simpler types of chucking lathes comprise a large proportion of these installations.

Some of the larger and better known makers in the Birmingham area find it impossible to accumulate any stock of machine tools, and a few are running day and night shifts. A substantial demand for machine tools on behalf of both colonial and home railways is expected in this district, and it is thought that India and Australia in particular are contemplating further extensive purchases in the near future. Very few orders are being placed for highly specialized machines of the more expensive types.

Although other areas cannot show the activity in machine tools that is prevalent in the Midlands, there is no need for despondency. Machine tool makers in Yorkshire are moderately well placed with orders, although the prices obtained generally show an extremely narrow margin of profit. One leading maker of gear generating machines is fairly busy, and there is a slightly improved demand for plain and universal milling machines. A good sign is the steady increase of work in hand among power transmission engineers. Business in lathes and small grinding machines is slow.

In Manchester and the surrounding manufacturing centers, the machine tool industry is not making very rapid headway; overseas markets hold out more promise than those at home. A firm making a well-known combination turret lathe has a fair number of orders in hand, chiefly for overseas.

In Scotland, manufacturers of general-purpose tools are not very busy. During the last few weeks the best customers have been makers of heavy electrical equipment and automobile manufacturers. Firms building special types of machines in which they have more or less of a monopoly are better placed than the majority of makers.

Overseas Trade in Machine Tools

During February the exports of machine tools showed an increase over those of January. The increase in tonnage was very pronounced, the figure of 1109 tons for January rising to 1475 tons in February. Although the increase in total value of exports of machine tools was not commensurate with the increase in tonnage, the rising tendency that has been in evidence during the last twelve months is maintained. The total value of exports during February was £150,400, as compared with £135,400 in January and about £85,000 twelve months ago. The value per ton of exports fell from £122 in January to £102 in February.

The imports of machine tools in February fell off considerably. As compared with 453 tons with a value of £76,350 in January, the figures for February were only 243 tons with a value of £47,424. The value per ton of imports reached the high water mark of £195.

The official returns for machine tool exports in January show that India was England's best customer, purchasing machine tools during the month to a value of over £20,000; South Africa took machine tools to the value of nearly £16,000; while Australia and New Zealand, respectively, took £14,000 and £11,000 worth. The best Continental customer was France with £11,500, while Japan bought about £6000 worth during the month.

American machine tools were imported to a value of £49,000 during January, while Germany supplied £18,900 worth; the imports of machine tools from the remaining countries were relatively insignificant both in amount and value. Grinding machines formed a large part of the imports from America, while presses and punching and shearing machines were an important proportion of Germany's quota.

The General Engineering Field

The engineering field as a whole, though still in a state of depression shows many bright spots. The heavy electrical branches continue to maintain a good position, particularly for generating equipment, and recently structural engineers have made a good deal of headway. Locomotive building firms, though not working to anything like full capacity, are able to maintain a fairly continuous stream of work through their shops. Steam engine builders show an improvement following a somewhat protracted period of dullness, and textile machinery firms find trade somewhat brisker; Germany is a good customer for such machinery at the present time. Apart from electrical work, the heavy engineering field has a rather poor outlook. Among rolling stock builders, the orders already in hand have been supplemented by extensive contracts for passenger cars.

The Automobile Industry

A record season is anticipated in the automobile and cycle industries. Makers in the Midlands are, with few exceptions, working day and night. The season's rush is now well under way. Production plans have been in hand for several months, and sales thus far show every prospect of justifying the general enterprise being shown. The demand generally has been estimated at double that of last year. In the cycle industry a similarly strenuous activity is to be seen, and cycles are being sent to all parts of the world in numbers that easily eclipse all previous records.

Shipbuilding—The Iron and Steel Industry

Orders for new vessels continue to be scarce, and some of the largest yards on the Clyde are now at work on their last vessels in hand. Continental competition is active, and the placing by British firms of one or two important orders with Germany has had the result of concentrating attention on the matter, and it is possible that important developments may take place.

In the iron and steel field, business is somewhat depressed; one of the brightest branches is iron founding, but founders are not getting very good prices for their work, and they do very little buying ahead. Makers of cast-iron pipes are very busy, the majority of them having enough work in hand to keep them busy for a year. The delay of rail orders for the replacement of British railroads is apparently due to the weakness of prices, as it is felt that the lowest point has not been reached. The non-ferrous markets are somewhat stronger than those of iron and steel.

OBITUARIES

A. LOWENER

A. Lowener, a well-known importer of American machine tools into the Scandinavian countries and a representative of more than twenty American firms, died at his home in Copenhagen, Denmark, April 14, at the age of about sixty years. Mr. Lowener was the owner of the firm of V. Lowener of Copenhagen, and was also largely interested in the firm of A. B. Lowener in Stockholm, Sweden, and the firm of Lowener-Mohn in Christiania, Norway. The Copenhagen firm was founded about 1890, the firms in Stockholm and Christiania being founded somewhat later. Previous to the revolution in Russia, a branch of the Danish firm was also established in Moscow, and in 1916 a New York office was opened, which later became an export and import business under the name of Lowener Engelsted. This firm also imports Dannemora tool steel into the United States and has sub-agencies and warehouses in Chicago, Detroit, Cincinnati, Philadelphia and Bridgeport.

Mr. Lowener was one of the pioneers in the importing of American machine tools into Europe. In addition to the business now carried on in the Scandinavian and Baltic countries, a considerable number of the simpler types of machine tools are being exported to China.

Mr. Lowener was a man of unusual business and organizing ability, and the system and methods employed in his Copenhagen business greatly impressed all visitors. The exhibition rooms of the Copenhagen firm are unusually attractive. His main interests were in the direction of furthering business relations with America, and he did a great deal to create a friendly feeling between Denmark and the United States in the commercial fields with which he came in contact. His home in Copenhagen was the center of American interests there, and every visitor from the United States was always welcome.

He supported liberally the American-Scandinavian Foundation, one of the purposes of which is to exchange students between American and Scandinavian universities. This foundation recently has sent as many as thirty American students a year to the Scandinavian universities and an equal number of Scandinavian students to American colleges.

As an indication of the public confidence Mr. Lowener enjoyed, and the esteem in which he was held, it should also be mentioned that he was a director representing the Danish Government in the Landmand Bank, the largest banking institution in Denmark. He was also unusually well liked by his employes, and took a personal interest in everyone connected with the business. Mr. Lowener is survived by his wife and two daughters.

JOHN A. McGREGOR

John A. McGregor, president of the Union Twist Drill Co., Athol, Mass., from the time the company was started twenty years ago, died after a lingering illness at his home in Athol, Mass., March 26. Mr. McGregor was born in Brookville, Nova Scotia, in 1856. He began serving an apprenticeship with the Brown & Sharpe Mfg. Co., Providence, R. I., in 1872, and remained with this concern until 1893, rising meanwhile to the position of assistant superintendent under Richmond Viall. In 1893 he left to become vice-president of Edwin Harrington Son & Co., Philadelphia, Pa., which position he held for two years, leaving there to become general superintendent of the Morse Twist Drill & Machine Co., New Bedford, Mass. After ten years with this company, he left in 1905 to become president of the newly formed Union Twist Drill Co., Athol, Mass. During the war he was also president of the Hopkins & Allen Arms Co., Norwich, Conn., manufacturing rifles for the Belgian Government.

Mr. McGregor was a man of strong character and marked executive ability. He took an active interest in the affairs of the town in which he lived, especially in the church work and in the work of the Y. M. C. A. He is survived by a wife and three daughters, as well as by two brothers, H. R. McGregor, superintendent of the Brown & Sharpe Mfg. Co., and James McGregor, a builder of Providence, R. I., and by a sister living in Nova Scotia.

Elwood Haynes, prominent metallurgist and pioneer in the automobile industry, died at his home in Kokomo, Ind., April 13, at the age of sixty-eight. Mr. Haynes was born in Portland, Ind., in 1857, and graduated in 1881 from the Worcester Polytechnic Institute. In 1887 he began to work on the design of a "horseless carriage," in 1892 he began its actual construction, and two years later he operated an automobile capable of making seven or eight miles an hour and running for several miles without a stop. This car is now on exhibition at the Smithsonian Institute, Washington, D. C. Later Mr. Haynes interested himself in the development of a stainless metal, in connection with which he developed stellite, and he was for many years president of the Haynes Stellite Co., as well as of the Haynes Automobile Co. In 1922 he was awarded the John Scott Medal for his discoveries in stainless metals.

Alfred L. Lovejoy, who was associated for a great many years with the Pratt & Whitney Co., of Hartford, Conn., and was widely known throughout the machinery industry, died at his home in Greenwich, Conn., on April 6, after a short illness. Mr. Lovejoy was fifty-nine years of age at the time of his death.

THE RAILROAD SITUATION

Freight traffic continues unusually heavy. During the first three months of this year a greater number of loaded freight cars were moved than ever before in the history of the railroads, and while at present there is an ample supply of surplus cars, western railroad managers are predicting a car shortage next fall. It has been stated that while the number of freight cars moved has been larger than ever before, the actual volume of freight moved has not exceeded past performances, because the cars have not been so heavily loaded, carrying less actual freight than in the past. There are no statistics to prove this, and it is difficult to say to what extent this statement is based on facts.

During the month of March the railroads placed orders for new equipment amounting to about $20,000,000, including 106 locomotives, 4700 freight cars, and 110 passenger cars. The output of locomotives is far below the capacity of the locomotive-building plants, and much below even what must be considered as a normal output to meet the ordinary demands of American railroads.

It is of interest to note that in the sixty-eighth Congress 271 railroad bills were introduced, of which only 5 had been passed when Congress adjourned on March 4. The remaining 266 died upon the adjournment of Congress.

* * *

THE LEIPZIG FAIR

All the space available at the Leipzig Fair held during March was occupied, and many exhibitors were forced to show their machinery in tents. Nearly all types of metal-working machinery were exhibited, from the smallest precision apparatus to the largest boring mills and presses. In the matter of sales, however, the fair is said not to have been very successful, as prices of German standard machines, according to information furnished by Trade Commissioner Theodore Pilger, of Berlin, to the Department of Commerce, are now above the world market prices, which is causing a depression in the machinery export trade. The domestic business survives as well as it does only because of the protection afforded by the restrictions prohibiting the importation of certain types of foreign machinery and equipment.

* * *

The extent to which general passenger service by airplanes has developed in Europe is not appreciated by many Americans. Beginning with April this year there will be fifteen regular services in Central Europe, apart from the services between London and Paris, and Paris and southwestern Europe. These services include regular passenger transportation by air between Berlin and London, Königsberg and Moscow, Berlin and Stockholm, Hamburg and London, Geneva and Budapest, and Zurich and Hamburg. It is stated that the average fare charged is not more than from four to six cents a mile.

* * *

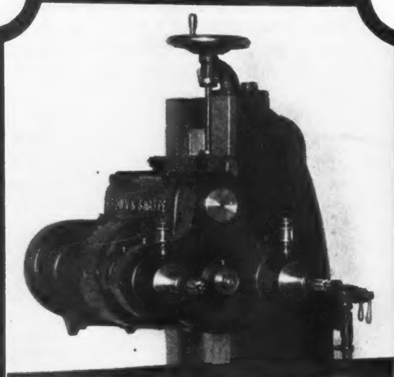
On April 15, a through package car service was established from points in the eastern United States to Havana, Cuba, via the Southern Railway System, the Florida East Coast Railway, and the Florida East Coast Car Ferry Co., cooperating with the main railway systems in the eastern United States.

* * *

The Forest Products Laboratory of the United States Forest Service, Madison, Wis., has issued two bulletins, No. 207 on "Glues for Use with Wood," and No. 211 on "Strong and Weak Glue Joints," which should be of interest to patternmakers and others in the mechanical industries that make use of glued wood joints.

UNLIMITED POSSIBILITIES

by Using Standard Machines with Attachments and Special Fixtures



Two Spindle Horizontal End Milling Attachment

Two Spindle Face Milling Attachment

Equip your plant with Brown & Sharpe Automatic Milling Machines and take advantage of the unlimited variety of work which these high production units are capable of handling.

By using attachments on these Standard Machines, their field of work is greatly broadened. They become the most versatile equipment in the shop and are kept busy continuously.

Special work-holding fixtures add speed to every operation and make the purchase of Brown & Sharpe Automatic Milling Machines an investment that returns big profits. Look into their possibilities on your work—send for full details about them.

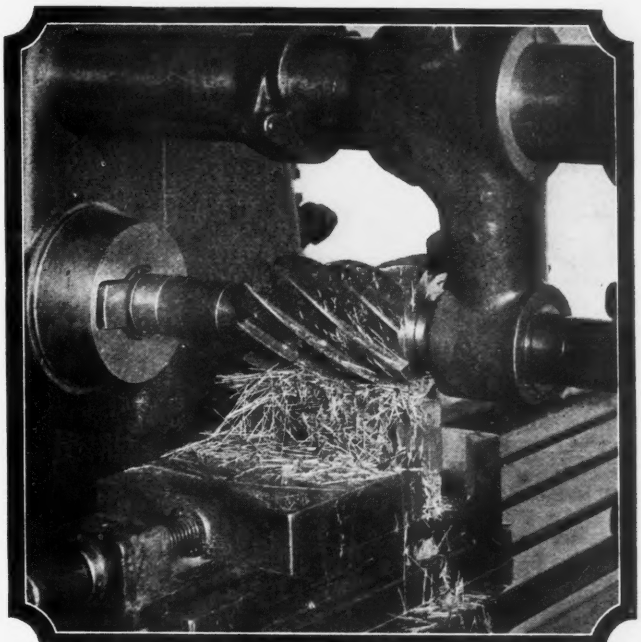
A new catalog describing these up-to-date production machines has just been issued. It tells how you can reduce non-productive time and economize on milling operations. Be sure to write for a copy.

B·S
TRADE MARK

Two Sizes
No. 21
for light work
No. 33
for heavier work

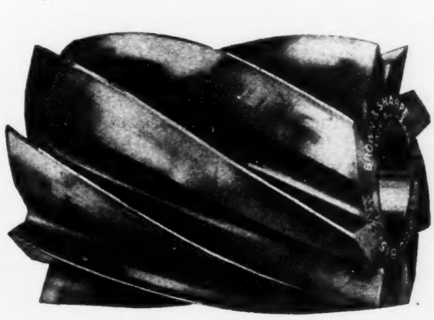
USE COARSE TOOTH CUTTERS

they give big production and good finish—



The smooth finish secured from Brown & Sharpe Coarse-Tooth Cutters is due chiefly to their continuous cutting action. This continuous cutting is made possible by the spiral formed teeth which smoothly shear off the metal. Portions of several teeth cut at the same time balancing the cut and eliminating vibrations. There is no "banging" or "hammering" causing chatter which is destructive to both machines and cutters.

For better finished surfaces and increased production try Brown & Sharpe Coarse-Tooth Cutters.



The strength, accuracy and durability of these high-grade cutters will help you to meet the demands of modern milling practice. Small Tool Catalog No. 29 lists the entire line of Brown & Sharpe Milling Cutters. Send for a copy today.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

TRADE NOTES

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., has removed its Pittsburg service station to 4909 Liberty Ave., Pittsburg.

WHITING CORPORATION, Harvey, Ill., has moved its Chicago district sales office from 945 Monadnock Block to 1502 Railway Exchange. The district sales manager is R. S. Hammond.

KEARNEY & TRECKER CORPORATION, Milwaukee, Wis., is moving its New York office to new quarters in the Singer Building, Room 1610, May 1. Walter P. Lotz will continue in charge.

MODERN REAMER SPECIALTY CO., Millersburg, Pa., has been formed to manufacture a line of helical-flute expansion and helical-blade adjustable reamers. Production is starting May 1.

UNIVERSAL BORING MACHINE CO., Hudson, Mass., has appointed Wilson-Brown, Inc., 2 Rector St., New York City, selling agent for eastern New York state and northern New Jersey.

OILGEAR CO., 657 Park St., Milwaukee, Wis., has appointed the Strong, Carlisle & Hammond Co., 1392 W. 3rd St., Cleveland, Ohio, agent for the sale of Oilgear pumps, variable-speed transmissions, hydraulic presses, and broaching machines.

BUFFALO BOLT CO., North Tonawanda, N. Y., manufacturer of bolts, nuts, wire, and bar material, has recently completed an addition to its factory to take care of the threading and milling of all jobbing orders. The addition is of brick and wood construction, 80 by 75 feet.

FOOTE BROS. GEAR & MACHINE CO., 232-242 N. Curtis St., Chicago, Ill., announces that at the annual stockholders' meeting the directors for the preceding year were unanimously re-elected. W. C. Davis was elected president; J. T. Kerwin, vice-president and treasurer; and A. W. Foote, secretary.

WINFIELD H. SMITH, manufacturer of speed-reducing gears and light power transmission machinery, is moving his office from 10 Lock St., Buffalo, N. Y., to the plant at Springville, N. Y. This change will not cause any interruption in work, as the manufacturing has been done at Springville for some time.

AMERICAN ENGINEERING CO., Philadelphia, Pa., manufacturer of Taylor stokers, recently presented diamond service emblems to thirty-two of its employes who have been with the company for thirty-two years or more. Gold emblems were presented to 275 other employes with records of from five to twenty-five years' service.

SELSON ENGINEERING CO. OF NEW YORK, INC., 120 Liberty St., New York City, announces that the London headquarters of the company are being moved from 83 Queen Victoria St., E.C. 4—the location occupied for the last fifty years—to the Selson Buildings, 26 Charles St., E.C. 1, London. The new quarters will offer better facilities for displaying the machinery and tools carried by the company.

FOOTE BROS. GEAR & MACHINE CO., 232-242 N. Curtis St., Chicago, Ill., has recently completed arrangements with John A. Park, Gran Hotel, Avenida Uruguay No. 12, Mexico City, Mexico, to represent the company in the sale of IXL speed reducers and gear products in Mexico. The company also announces the opening of a new sales office at 72 Ontario St., Providence, R. I., with George Walsh in charge.

MASTER ELECTRIC CO., 448 First St., Dayton, Ohio, manufacturer of motors, has purchased a new factory at Linden Ave., adjacent to the Pennsylvania Railroad, from the Emmons Co. The property was formerly owned by the Davis Sewing Machine Co. The new factory comprises a three-story modern concrete building containing about 60,000 square feet of floor space, and four smaller auxiliary factory buildings.

BOTWINIK BROS., New Haven, Conn., have purchased the plant of the New Haven Carriage Co., on Water St., and have moved their entire stock at Sylvan Ave., 92 Orchard St., Winchester Ave., Bridgeport, Conn. warehouse, State St. motor department, and several other small warehouses, to the new location in order to bring all of the stock under one roof. The newly acquired plant contains over 150,000 square feet of floor space.

FIRTH-STERLING STEEL CO., 710 W. Lake St., Chicago, Ill. (E. S. Jackman & Co., agents), has moved its Los Angeles offices from 336 E. Third St., to larger quarters at 2154 Santa Fe Ave. William E. Nelson, who has been with the company almost twenty-five years, is Pacific Coast representative. The Cleveland office of the company has also been moved from its former location at 333 Frankfort Ave., to 1424 E. 25th St., N.E., Cleveland, Ohio.

C. F. PEASE CO., 822 N. Franklin St., Chicago, Ill., has announced a prize competition in which $100 will be paid to the person submitting the slogan best adapted for promoting the use of blueprints. Each slogan submitted must be accompanied by a letter of from 100 to 500 words, stating why the particular slogan is suggested. Complete information in regard to the contest, which closes June 15, may be obtained by addressing the C. F. Pease Co.

LINDE AIR PRODUCTS CO., 30 E. 42nd St., New York City, manufacturer and distributor of oxygen for welding and cutting, has recently opened the following district sales offices: 716 First National Soo Line Building, Minneapolis, Minn., with C. E. Donegan as district sales manager; 409 Lincoln Life Building, Birmingham, Ala., with W. A. K. Kopp as district sales manager; 508 Exchange National Bank Building, Tulsa, Okla., with G. D. Grubb as district sales manager. The company also announces the appointment of J. W. Foster as district sales manager at Baltimore.

FARREL FOUNDRY & MACHINE CO., INC., Buffalo, N. Y., has appointed Robert P. Waller, 916 Little Bldg., Boston, Mass., district representative for the company, to handle the sales of Sykes herringbone gears and reduction units in the territory east of the Connecticut River. J. P. Flippen, 649 Union Trust Bldg., Pittsburg, Pa., has been appointed district representative for the company in the territory covered by western Pennsylvania, the eastern part of Ohio, and the state of West Virginia. The W. J. Westaway Co. of Hamilton, Ontario, Canada, has been appointed district representative covering the eastern half of the province of Ontario.

INTERNATIONAL CHEMICAL CO., Philadelphia, Pa., held a conference of the company's sales engineers in the middle-western territories at Hotel LaSalle, Chicago, April 3. At this conference technical problems encountered in the application of the cleaning compounds and lubricants made by the company were fully discussed. Results obtained through tests with different compounds were recorded, and a new material which has been developed for heavy-duty cleaning in railroad shops was discussed. By conferences of this kind, the company expects to keep its customers fully informed, through its sales engineers, of the most modern methods in handling difficult cleaning and lubrication problems.

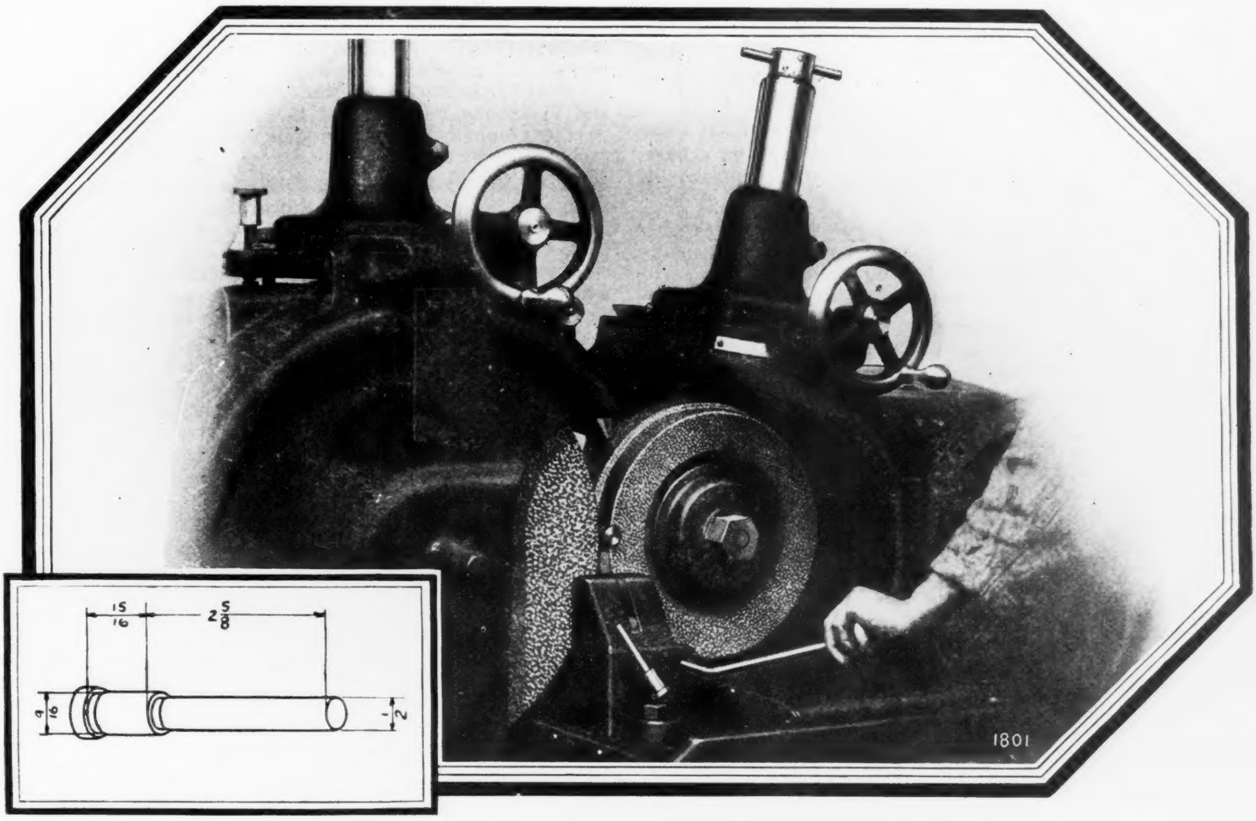
FOOTE-BURT CO., Cleveland, Ohio, manufacturer of drilling machines, announces that the company has purchased the quick-change-speed sensitive drilling machine business of the Sipp Machine Co., Paterson, N. J., which line is made in three sizes, each of which can be furnished with either single or multiple spindles. The Sipp line of drilling machines will in the future be built in the Foote-Burt Co.'s plant in Cleveland. Sixteen standard types of drilling machines are now included in the Foote-Burt line, and, in addition, the company designs and builds special drilling equipment of the single-purpose type for special work, covering a range from the drilling of small holes with No. 80 drills, to extremely heavy work running up to 6 inches diameter in solid steel.

G. A. GRAY CO., Cincinnati, Ohio, manufacturer of metal planers, announces that the company has purchased a six and one-half acre piece of ground at the intersection of Woodburn Ave., and the C. L. & N. Division of the Pennsylvania Railroad in Cincinnati, on which the company will erect a new shop, 210 by 420 feet. The main bay will be 60 feet wide, 420 feet long, and 25 feet high under the crane hook. Parallel to this bay is another, 50 feet wide and 19 feet under the crane hook; auxiliary bays are arranged at right angles to the two main bays, 40 feet wide and 100 feet long. The main bays will be served by one 15-ton and two 20-ton cranes, and the auxiliary bays by 3-ton cranes. Adjoining the shop will be a two-story office building. Building operations will start at once, and it is expected that the plant will be in operation in the fall.

* * *

METAL TRADES ASSOCIATION MEETING

The twenty-seventh convention of the National Metal Trades Association was held in Cleveland, Ohio, April 22. Among the important addresses at the meeting was one on "Common Interests between Agriculture and Other Industries," by W. J. Thompson of South China, Me. Louis Ruthenburg, general manager of the Yellow Sleeve Valve Engine Works, East Moline, Ill., spoke on "Training, Developing, and Promoting Foremen," and R. W. Boyden, president of the Boston Chamber of Commerce, Boston, Mass., spoke on "International Debts." Hon. John C. Barrett of Washington, D. C., delivered an address on "America and World Commerce."



ANOTHER GOOD CENTERLESS JOB

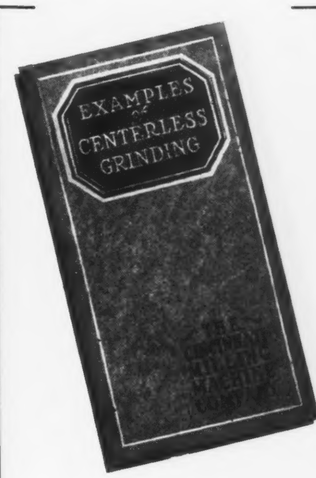
ON THE CINCINNATI CENTERLESS GRINDER (PATENTED)

This hardened steel driving pin is ground by the in-feed or shoulder grinding method. Both the grinding wheel and the regulating wheel are trued to accommodate the two different diameters. The work support blade is also set to take this bevel dimension. A special adjustable diamond holder containing two diamonds for truing the grinding wheel to the two dimensions, is provided on the truing device and saves time in dressing the wheel to this step. Limits, round within .0002 in., straight within .0003 in. Size within .0003 in. Production per hour 215 pieces. The Cincinnati Centerless Grinder is producing unusually high profits.

PATENT NOTICE—

In addition to our own patents, we are licensed under all the basic centerless grinding patents, including the Heim re-issue patent 15035, recently sustained by the decision of the U. S. Circuit Court of Appeals. In the purchase of our machines, therefore, our customers are protected against infringement of centerless grinding patents.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO



THE complete story of centerless grinding is told in this 50 page book. Complete production data on form grinding, shoulder grinding, straight-through, two diameter and other work illustrated. All sorts of materials are ground. Send for your book today.

CINCINNATI CENTERLESS GRINDERS

PERSONALS

RALL R. JAVENS has become sales director of the Alvord Reamer & Tool Co., Millersburg, Pa., and will be located at the main office in Millersburg.

FRANK P. CALLAGHAN, chief engineer for Foote Bros. Gear & Machine Co., Chicago, Ill., left April 4 for Cuba on a business trip involving engineering work for the company in that territory.

J. A. GELZER, for many years connected with the Wagner automotive sales department, has been made sales manager of the Automotive Division of the Wagner Electric Corporation, St. Louis, Mo., with headquarters at the home office.

JAMES E. SHEARER, assistant sales manager of the Industrial Works, Bay City, Mich., has moved his headquarters from the home office to the New York office of the company at 50 Church St. George T. Sinks continues in charge of the New York district.

LYLE MARSHALL, former manager of the service department of the Industrial Works, Bay City, Mich., and later connected with the Chicago office, has recently been appointed district sales manager with offices at 619 Dixie Terminal Bldg., Cincinnati, Ohio.

ALFRED W. LOCKWOOD has joined the sales organization of the Bridgeport Brass Co., Bridgeport, Conn., as a special representative handling brass pipe and flush valves. Mr. Lockwood's headquarters will be at the New York office in the Pershing Square Building.

HENRY R. BETTIS has been elected vice-president and sales manager of the Midwestern Tool Co., 5215 Ravenswood Ave., Chicago, Ill. Mr. Bettis was formerly connected with the Illinois Tool Works of Chicago, Ill., in the capacity of sales manager, and prior to that was associated with the Union Twist Drill Co., of Athol, Mass.

WILLARD D. SMITH, formerly general sales manager of the St. Louis Pump & Equipment Co., has joined the staff of the Davis Boring Tool Co., St. Louis, Mo., as manager of railroad sales. Mr. Smith will devote his time to the study of the railroad field, with a view to determining all possible applications of Davis boring tools in railroad shops.

A. MCCORMICK, has joined the sales organization of the Chicago Belting Co., 113 N. Green St., Chicago, Ill. Mr. McCormick will represent the company in Arkansas, Tennessee, and northern Mississippi. He will work with Hollis & Co. of Little Rock, and the J. E. Dilworth Co. of Memphis and Vicksburg, and will also be direct factory representative of the company. His headquarters will be in Memphis, Tenn.

DANIEL H. MELOCHE of the Holley Carburetor Co., Detroit, Mich., has been awarded the Edward Longstreth Medal by the Franklin Institute, Philadelphia, Pa., for his invention embodied in long-life molds. Mr. Meloche perfected a commercial process for pouring molten metal into metal molds which has greatly decreased production costs, more than 40,000 castings having been made from a single mold without replacement by this process.

CHARLES S. DURKEE has been appointed western district sales manager for J. H. Williams & Co., Buffalo, N. Y., manufacturer of drop-forgings and drop-forged tools, in charge of the sale of stock products in the West and Southwest, with offices and warehouse at 117 N. Jefferson St., Chicago, Ill. Mr. Durkee has been with the company for eighteen years, and during the last two years has been in charge of the central sales district with headquarters at Buffalo.

C. M. ROBERTSON has resigned as vice-president of the Dale Machinery Co., Chicago, Ill. Mr. Robertson was for many years general superintendent of the Colburn Machine Tool Co., going to Chicago as the company's representative seventeen years ago. He later became associated with the Dale Machinery Co., becoming Chicago sales manager when that company was absorbed by the Consolidated Machine Tool Co., and later vice-president of the present Dale Machinery Co. Mr. Robertson has not announced his future plans.

A. J. GILLESPIE has been appointed sales representative for the Cleveland office by the Wollmar Engineering Corporation, 224 E. 42nd St., New York City, manufacturer of N K A ball and disk bearings. Mr. Gillespie has been connected with the ball-bearing industry in Ohio for over six years, having been district manager for the Hess-Bright Mfg. Co., and the S K F Industries, Inc., and for the last three years engaged in anti-friction engineering as president of the A. J. Gillespie Co. His headquarters will be at 8500 Lake Ave., Cleveland, Ohio.

COMING EVENTS

MAY 5-7—Joint convention of the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association in Atlanta, Ga.; headquarters, Atlanta-Biltmore Hotel. Secretary-treasurer, F. D. Mitchell, 1819 Broadway, New York City.

MAY 6-8—National convention of the Society of Industrial Engineers in Cleveland, Ohio; headquarters, Hotel Winton. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

MAY 7-9—Ninth annual meeting of the American Gear Manufacturers' Association at the William Penn Hotel, Pittsburg, Pa., T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

MAY 11-23—Southern Exposition to be held at Grand Central Palace, New York City. Further information may be obtained from William G. Sirrine, Greenville, S. C., or the Merchants' Association of New York, 233 Broadway, New York.

MAY 18-21—Spring meeting of the American Society of Mechanical Engineers in Milwaukee, Wis. Secretary, Calvin W. Rice, 29 W. 39th St., New York City.

MAY 20-23—Second annual automotive service convention and automotive maintenance equipment show to be held in the General Motors Bldg., Detroit, Mich. Convention and show are under the direction of the National Automobile Chamber of Commerce, New York City, assisted by a number of other associations in the automotive field.

MAY 28-30—Spring sectional meeting of the American Society for Steel Treating in Schenectady, N. Y.; headquarters, Hotel Van Curler. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

JUNE 16-19—Summer meeting of the Society of Automotive Engineers at Greenbrier Hotel, White Sulphur Springs, W. Va. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

JUNE 22-26—Annual meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary-Treasurer, C. L. Warwick, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

JUNE 24-26 — Twelfth National Foreign Trade Convention in Seattle, Wash. Secretary of the National Foreign Trade Council, O. K. Davis, India House, Hanover Square, New York City.

SEPTEMBER 8-11—Machine Tool Exhibition in the Mason Laboratory, Sheffield Scientific School, Yale University, New Haven, Conn. H. R. Westcott, chairman, 400 Temple St., New Haven, Conn.

SEPTEMBER 14-18—Annual convention of the American Society for Steel Treating, and Seventh National Steel Exposition, to be held at the Public Auditorium, Cleveland, Ohio. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 15-16—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

SEPTEMBER 28-October 3—Tenth exposition of chemical industries at Grand Central Palace, New York City.

OCTOBER 5-9—Annual convention of the American Foundrymen's Association at Syracuse, N. Y. An exhibition of foundry and machine shop equipment and supplies will be held in connection with the convention.

NOVEMBER 30-December 5—Fourth national exposition of power and mechanical engineering to be held in the Grand Central Palace, New York City.

SOCIETIES, SCHOOLS AND COLLEGES

MELBOURNE TECHNICAL SCHOOL, 124 Latrobe St., Melbourne, Australia. Prospectus for 1925, containing calendar, outline of courses, and other information relating to the school.

ELECTRIC POWER CLUB, B. F. Keith Bldg., Cleveland, Ohio, has published a new edition of the transformer standards of the club, which contains all the new standards that have been adopted since the previous edition (1924) was printed.

NEW BOOKS AND PAMPHLETS

BRIQUETTING OF ZINC ORES. By B. M. O'Harra. 67 pages, 6 by 9 inches. Published by the University of Missouri, Rolla, Mo., as a Technical Bulletin of the School of Mines and Metallurgy.

MECHANICAL DRAWING PROBLEMS. By John F. Faber. 222 pages, 6 by 9 inches. Published by the Bruce Publishing Co., 354 Milwaukee St., Milwaukee, Wis. Price, $2.50.

This book contains a group of mechanical drafting problems intended to supplement textbooks on drawing. The book consists almost entirely of blueprints, the text being confined to brief instructions covering each class of problems. Many of the pictorial representations were made from machine parts and working drawings obtained from manufacturing plants. The problems are divided into eight groups, dealing with elementary free-hand sketching; instrumental drawing; sections; intersections and developments; pictorial drawing; detail drawing; assembling drawings; data and tables.

THE DESIGN OF CRANES AND HOISTS. By Hermann Wilda. 159 pages, 4½ by 7¼ inches. Published by Scott, Greenwood & Son, 8 Broadway, Ludgate Hill, E. C. 4, London, England (American agent, D. Van Nostrand Co., 8 Warren St., New York City). Price, $2.50, postpaid.

This is the second edition of a book on the design of cranes and hoists, originally translated from the German. The book is divided into two chapters or sections, the first of which deals with the elements of lifting tackle, including rope, chains, pulleys, drums, wheels and sprockets, hooks, cranks, holding gears, brakes, reversing gears, pinions, worm-gearing, ball and roller bearings, bolts, couplings, etc. The second section covers different types of cranes and hoists.

JOHN EDSON SWEET. By Albert W. Smith. 220 pages, 6 by 9 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, cloth binding $3.75; three-quarters morocco binding, $7.50.

This book contains the life story of the man who was instrumental in founding the American Society of Mechanical Engineers, and whose influence in the engineering field was widespread. The opening paragraph epitomizes the character of the man in these words: "John Edson Sweet loved his fellow men, was forgetful of self in his anxiety to serve others, was filled with enthusiasm for high ideals of character and work, scorned the second best in all his strivings and was blessed with a rare sense of humor and with a genius for friendship." The book is divided into two parts: The first part tells the story of Professor Sweet's life and of his engineering achievements. The second part consists of addresses and letters.

HENDRICKS' COMMERCIAL REGISTER. 2453 pages, 8 by 11 inches. Published by the S. E. Hendricks Co., Inc., 70 Fifth Ave., New York City. Price, $12.

This is the thirty-third edition of this well-known directory for buyers and sellers covering all the manufactured products of the United States. The general arrangement of the book is the same as in preceding editions. The first section is an alphabetical list of manufacturers, giving the name and address and, in some cases, branch offices and local distributors. This section covers 318 pages. The book is completely indexed and cross-indexed, the index filling 134 pages of four columns each. Following the index comes the main section of the book—the classified products section—which contains alphabetical lists of the manufacturers of the various products, arranged under the names of the products. This section comprises 1780 pages of three columns each. The last section contains an alphabetical list of trade names occupying 213 pages.

NEW CATALOGUES AND CIRCULARS

MOTORS. Electric Machinery Mfg. Co., Minneapolis, Minn. Bulletin 875, treating of synchronous motors in pulp and paper mills.

TRUCKS. Plimpton Lift Truck Co., Stamford, Conn. Pamphlet outlining the features of Plimpton lift trucks, and illustrating various applications.

PUMPS. Leiman Bros., 60E Lispenard St., New York City. Catalogue illustrating and describing rotary air, gas, and oil pumps, and sand-blasting machines.

DRILLING MACHINES. Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. Leaflet illustrating and describing the Buffalo 20-inch back-geared upright drill.

FLEXIBLE COUPLINGS. Charles Bond Co., 617 Arch St., Philadelphia, Pa. Booklet F, illustrating and describing Grundy flexible insulated couplings and Mather flexible couplings.

HEATERS. Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. Circular containing information on the Buffalo "Breezo-Fin" motor-driven heaters, which are made in 18- and 24-inch sizes.

GENERATORS. General Electric Co., Schenectady, N. Y. Bulletin 42567, descriptive of the General Electric sine wave generator. Different testing applications of this generator are explained.

PULLEYS. W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill. Circular of Jones pulleys, illustrating some of the many types of solid and split pulleys made by this concern.

METALS. Hammacher, Schlemmer & Co., Inc., Fourth Ave. and 13th St., New York City. Pamphlet of brass, copper, and bronze, showing the principal sizes and shapes carried in stock by this concern.

REMANUFACTURED MACHINES. Hill, Clarke & Co. of Chicago, 649 W. Washington Blvd., Chicago, Ill. Circular containing a list of the remanufactured machine tools at present carried in stock by this company.

RIVETERS. Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Bulletin R-203, containing information on the Hanna line of rapid punch riveters, which can be mounted on a wall or arranged for portable use.

BOLTS and NUTS. Buffalo Bolt Co., North Tonawanda, N. Y., is distributing a circular in the form of an illustrated card giving data relating to two newly assorted packages of carriage bolts and nuts offered to the trade by this concern.

ELECTRIC LAMPS. Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin L.D. 119B, descriptive of the manufacture of the Edison Mazda lamp. Bulletin L.D. 113A, containing data on miniature Edison Mazda lamps.

INDICATING AND RECORDING INSTRUMENTS. Foxboro Co., Inc., Neponset Ave., Foxboro, Mass. Circular descriptive of the improved helical tube movement incorporated in Foxboro recording gages and thermometers.

STEEL. Anchor Drawn Steel Co., Latrobe, Pa. Catalogue and price list of Anchor cold-drawn steels, including high-speed drill rods, carbon drill rods, special shapes, stainless steel, special tap steel, chaser die steel, and alloy welding wire.

BALL AND ROLLER BEARINGS. Gwilliam Co., 23 Flatbush Ave., Brooklyn, N. Y. Catalogue 8, containing dimensions and prices of the various sizes of Gwilliam ball and roller thrust bearings, journal roller bearings, and special bearings.

SAWS. Crescent Machine Co., 56 Main St., Leetonia, Ohio. Catalogue illustrating and describing Crescent saw tables, which have been developed to meet the requirements of a wide range of users. Complete dimensions are given for the various styles and sizes.

MANGANESE STEEL. American Manganese Steel Co., Chicago Heights, Ill. Circular containing a list of various applications of manganese steel. The leaflet also brings out points on the characteristics and properties of manganese steel in questionnaire style.

MILLING MACHINES. Kearney & Trecker Corporation, Milwaukee, Wis. Bulletin illustrating and describing Kearney & Trecker motor-in-the-base milling machines. Floor plans and specifications covering the different sizes of this line of machines are included.

HEATERS. American Blower Co., Detroit, Mich. Leaflet illustrating and describing the American direct-fired unit heater, which is especially adapted for heating foundries, warehouses, woodworking plants, and machine shops where the machines are electrically driven.

TURRET LATHES. Warner & Swasey Co., Cleveland, Ohio. Leaflet illustrating a job of machining motor cylinders performed on a Warner & Swasey No. 1-A turret lathe. Figures are given, showing the reduction in time that can be effected by this method of handling the work.

WIRE CLOTH. Newark Wire Cloth Co., 351 Verona Ave., Newark, N. J. Catalogue 25, containing complete information and list prices covering the various kinds of wire cloth made by this company, including steel, brass, copper, bronze, phosphor-bronze, and monel metal wire cloth.

SPEED REDUCTION UNITS. Boston Gear Works Sales Co., Norfolk Downs (Quincy), Mass. Booklet C2-25 entitled "Speed and Power," containing illustrations and descriptive material, including specifications and prices, covering the line of speed reduction units made by this company.

PYROMETERS. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago, Ill. Catalogue illustrating and describing in detail Republic pyrometers. Considerable general information is included, such as how to select thermocouples; pyrometer maintenance; cold junction errors and their elimination, etc.

MULT-AU-MATICS. Bullard Machine Tool Co., Bridgeport, Conn. Circular illustrating diagrammatically the use of the Bullard Mult-Au-Matic in automotive work. The pamphlet shows the different steps in machining differential housings and gear-cases, and gives the feed and speed range, and production time for each setting.

TURRET LATHES. Jones & Lamson Machine Co., Springfield, Vt. Pamphlet entitled "The Problems of Your Shop." This is the second of a series of pamphlets discussing different classes of work that can be effectively handled on J & L turret lathes. The present pamphlet treats of bar work, and describes in detail the production of a typical part.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Engineering data bulletins for FE edition of New Departure Reference Book, containing data on the mounting and handling of New Departure ball bearings; ball bearing closures; calculations of bearing loads due to gears; angular contact ball bearings; and ball bearing sizes for horizontal electric motors.

WIRE FORMING MACHINES AND CHUCKING MACHINES. Baird Machine Co., Bridgeport, Conn. Circular illustrating various examples of work produced on Baird four-slide wire forming machines. The circular also illustrates the Baird 6- by 6-inch six-spindle horizontal chucking machine, a number of styles of foot presses, and a tilting steam drying barrel.

STELLITE. Haynes Stellite Co., 30 E. 42nd St., New York City. Pamphlet entitled "Faster Milling for Greater Profits." This book has been written with a view to producing not a mere catalogue, but a text-book on modern milling practice. It treats of the use of stellite in milling various metals, rubber, and fiber. General information is given on speeds and feeds, operating conditions, the adjustment of milling machines and grinding machines, and remedies for common causes of trouble. Cutter grinding is taken up at some length, and the calculation of cutter costs is described.

MACHINERY AND TOOLS. Brown & Sharpe Mfg. Co., Providence, R. I. General catalogue 138, containing over 600 pages listing the complete line of machinery, tools, cutters, attachments, etc., made by this concern. Detailed descriptions, as well as tabulated specifications and dimensions, are given for each product. Several new additions have been made to the line since the previous catalogue was issued. The catalogue is made in pocket size, 3¾ by 5¾ inches, for convenient reference. Copies may be obtained upon request from any of the company's domestic or foreign agents or from the factory direct.